THE

DYER's ASSISTANT

IN THE

ART of DYING WOOL

AND

WOOLLEN GOODS.

EXTRACTED FROM

The Philosophical and Chymical Works of those Most Eminent AUTHORS,

Mess. FERGUSON, DUFAY, HELLOT, GEOFFERY, COLBERT, AND

That Reputable FRENCH DYER, Mons. De JULIENNE.

TRANSLATED from the FRENCH.

WITH

ADDITIONS

AND

PRACTICAL EXPERIMENTS.

By JAMES HAIGH,
Late SILK and MUSLIN DYER, LEEDS.

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THE

PREFACE.

THERE are very few arts ſo extenſive as that of dying; and, altho' thoſe principal commodities, cloathing and furniture, receive their chief improvement and value therefrom, it is nevertheleſs very far from being brought to perfection. A long practice, ſound judgment, and great attention will form a good and expert Dyer. Many Dyers can work with ſucceſs in a number of colours only which depend on each other, and are entirely ignorant of the reſt, or have but a very imperfect idea of them.

A Philoſopher, who ſtudies the art of dying, is in ſome meaſure aſtoniſhed at the multiplicity of new objects which it affords; every ſtep preſents new difficulties and obſcurities, without hopes

of any inſtruction from the common workmen, who ſeldom know more than facts and cuſtom. Their manner of explaining themſelves, and their common terms, only afford more darkneſs, which the uncommon and often uſeleſs circumſtances of their proceedings render more obſcure.

Before we enter into the particulars of dying wool, it is neceſſary to give an idea of the primary colours, or rather of thoſe which bear this name by the artiſts; for it will appear by reading the celebrated works of Sir Iſaac Newton on Light and Colours, that they bear no affinity with thoſe which the Philoſophers call by that name. They are thus named by the workmen, becauſe, by the nature of the ingredients of which they are compoſed, they are the baſis from whence all others are derived. This diviſion of colours, and the idea which I intend to give of them, are alſo common to the different kinds of dying.

The five primary colours are blue, red, yellow, brown, and black. Each

of theſe can furniſh a great number of ſhades, from the lighteſt to the darkeſt; and from the combination of two or more of theſe different ſhades, ariſe all the colours in nature. Colours are oftentimes darkened, or made light, or conſiderably changed, by ingredients that have no colour in themſelves; ſuch are the acid, the alkalis, and the neutral ſalts, lime, urine, arſenic, allum, and ſome others: and in the greateſt part of dyes, the wool and woollen goods are prepared with ſome of theſe ingredients, which of themſelves give little or no colour. It may eaſily be conceived what an infinite variety muſt ariſe from the mixture of theſe different matters, or even from the manner of uſing them; and what attention muſt be given to the minuteſt circumſtances, ſo as perfectly to ſucceed in an art ſo complicated, and in which there are many difficulties.

It is not needful to be very particular in deſcribing the utenſils of a dye-houſe, as they are commonly known; this work being deſigned for the expe-

rienced Dyer. A dye-houſe ſhould, however, be erected on a ſpacious plan, roofed over, but admitting a good light, and as nigh as poſſible to a running water, which is very neceſſary, either to prepare the wool before it is dyed, or to waſh it afterwards. The coppers ſhould be ſet at the diſtance of eight or ten feet, and two or more vats for the blue, according to the quantity of work that is to be carried on.

The moſt important point in dying the primitive blue is to ſet the vat properly at work, and conduct her till ſhe is in a ſtate to yield her blue. The ſize of the woad vat is not fixed, as it depends upon neceſſity or pleaſure. A vat containing a hogſhead, or half that quantity, has often been uſed with ſucceſs; but then they muſt be prevented by ſome means from cooling too ſuddenly, otherwiſe theſe ſmall vats will fail.

Another kind of vat is prepared for blue: this is called the indigo vat, becauſe it is the indigo alone that gives it the

the colour. Thoſe that uſe the woad vat do not commonly uſe the indigo one.

There are two methods of dying wool of any colour; the one is called dying in the great, the other in the leſſer dye. The firſt is done by means of drugs or ingredients that procure a laſting dye, reſiſt the action of the air and ſun, and are not eaſily ſtained by ſharp or corroſive liquors. The contrary happens to colours of the leſſer dye. The air fades them in a ſhort time, mor particularly if expoſed to the ſun; moſt liquors ſtain them, ſo as to make them loſe their firſt colour. It is extraordinary that, as there is a method of making all kinds of colours by the great dye, the uſe of the leſſer ſhould be tolerated; but three reaſons make it difficult, if not impoſſible to prevent this practice.

1ſt, The work is much eaſier. Moſt colours and ſhades which give the greateſt trouble in the great, are eaſily carried on in the leſſer dye.

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2d, Moſt colours in the leſſer are more bright and lively than thoſe of the great.

3d, For this reaſon, which carries more weight, the leſſer dye is carried on much cheaper than the great. This is ſufficient to determine ſome men to do all in their power to carry it on in preference to the other. Hence it is that the true knowledge of chymiſtry, to which the art of dying owes its origin, is of ſo much uſe.

It may be obſerved, that all laſting colours are called colours of the great, and the others of the leſſer dye. Sometimes the firſt are called fine, and the latter falſe colours; but theſe expreſſions are equivocal, for the fine are ſometimes confounded with the high colours, which are thoſe in whoſe compoſition cochineal enters; therefore, to avoid all obſcurity, I ſhall call the firſt colours of the great, and the latter colours of the leſſer dye.

Experiments (which are the beſt guides in natural philoſophy as well as arts)

arts) plainly ſhew, that the difference of colours, according to the foregoing diſtinction, partly depends on the preparation of the ſubject that is to be dyed, and partly on the choice of the ingredients which are afterwards uſed to give it the colour. I therefore think it may be laid down as a general principle, that all the inviſible proceſs of dying conſiſts in dilating the pores of the body that is to be dyed, and depoſiting therein particles of a foreign matter, which are to be detained by a kind of cement which prevents the ſun or rain from changing them. To make choice of the colouring particles of ſuch a durability that they may be retained, and ſufficiently ſet in the pores of the ſubject opened by the heat of boiling water, then contracted by the cold, and afterwards plaiſtered over with a kind of cement left behind with the ſalts uſed for their preparation, that the pores of the wool or woollen ſtuff ought to be cleanſed, enlarged, cemented, and then contracted, that the colouring atom may be contained in a laſting manner.

Experiments

Experiments alſo ſhew that there is no colouring ingredient belonging to the great dye which has not more or leſs an aſtringent and precipitant quality. That this is ſufficient to ſeparate the earth of the allum; this earth, joined to the colouring atoms, forms a kind of laque, ſimilar to that uſed by the painters, but infinitely finer. That in bright colours, ſuch as ſcarlet, where allum cannot be uſed, another body muſt be ſubſtituted to ſupply the colouring atoms (block-tin gives this baſis to the ſcarlet dye). When all theſe ſmall atoms of earthy-coloured laque have inſinuated themſelves into the pores of the ſubject that is dilated, the cement which the tartar leaves behind ſerves to maſticate theſe atoms; and laſtly, the contracting of the pores, cauſed by the cold, ſerves to retain them.

It is certain that the colours of the falſe dye have that defect only becauſe the ſubject is not ſufficiently prepared; ſo that the colouring particles being only depoſited on its plain ſurface, it

is impoſſible but the leaſt action of the air or ſun muſt deprive them of part, if not of the whole. If a method was diſcovered to give to the colouring parts of dying woods the neceſſary aſtriction which they require, and if the wool at the ſame time was prepared to receive them (as it is the red of madder) I am convinced, by thirty experiments, that theſe woods might be made as uſeful in the great as they have hitherto been in the leſſer dye.

What I have ſaid ſhall be applied in the ſequel of this treatiſe, where I ſhall ſhew what engaged me to uſe them as general principles.

I ſhould have been glad to have ſeen a work of this ſort (knowing the great need there is of a chymical underſtanding of this art) ſigned with the name of ſome perſon of diſtinction, to have given it a better face; yet, in defect of that, I was prevailed upon to undertake the tedious taſk. I dare not flatter myſelf to have brought it to its laſt perfection, as arts daily improve, and this

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in particular; but I hope ſome acknowledgement will be due to me for bringing this matter a little further out of that obſcurity in which it has laid, and for aſſiſting the Dyers in making diſcoveries to help to perfect this moſt uſeful art.

I ſhall now proceed to examine the five primary colours above-mentioned, and give the different methods of preparing them after the moſt ſolid and permanent manner.

JAMES HAIGH.

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FINIS.



THE

INTRODUCTION.

THE materials of which cloths are made, for the moſt part are naturally of dull and gloomy colours. Garments would conſequently have had a diſagreeable uniformity, if this art had not been found out to remedy it, and vary their ſhades. The accidental bruiſing of fruits or herbs, the effect of rain upon certain earths and minerals might ſuggeſt the firſt hint of the art of dying, and of the materials proper for it. Every climate furniſhes man with ferruginous earths, with boles of all colours, with ſaline and vegetable materials for this art. The difficulty muſt have been to find the art of applying them. But how many trials and eſſays muſt have been made, before they found out the moſt proper methods of applying them to ſtuffs, ſo as to ſtain them with beautiful and laſting colours? In this conſiſts the principal excellence of the Dyer's art,

art, one of the moſt ingenious and difficult which we know.

Dying is performed by means of limes, ſalts, waters, leys, fermentations, macerations, &c. It is certain that dying is very ancient. The Chineſe pretend that they owe the diſcovery of it to Hoan-ti, one of their firſt ſovereigns.

One of the moſt agreeable effects of the art of dying, is the diverſifying the colours of ſtuffs. There are two ways by which this agreeable variety is produced, either by needle-work with threads of different colours, on an uniform ground, or by making uſe of yarn of different colours in the weaving.

The firſt of theſe inventions is attributed to the Phrygians, a very ancient nation; the laſt to the Babylonians. Many things incline us to think that theſe arts were known even in the times of which we are now treating. The great progreſs theſe arts had made in the days of Moſes, ſuppoſes that they had been diſcovered long before. It appears to me certain, then, that the arts of embroidery and weaving ſtuffs of various colours, were invented in the ages we

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are now upon. But I ſhall not inſiſt on the manner in which they were then practiſed, as I can ſay nothing ſatisfactory upon that ſubject.

Another art nearly related to that of dying, is that of cleaning and whitening garments, when they have been ſtained and ſullied. Water alone is not ſufficient for this. We muſt communicate to it, by means of powders, aſhes, &c. that deterſive quality which is neceſſary to extract the ſtains which they have contracted. The ancients knew nothing of ſoap, but ſupplied the want of it by various means. Job ſpeaks of waſhing his garments in a pit with the herb borith. This paſſage ſhews that the method of cleaning garments in theſe ages, was by throwing them into a pit full of water, impregnated with ſome kind of aſhes; a method which ſeems to have been very univerſal in theſe firſt times. Homer deſcribes Nauſicaa and her companions waſhing their garments, by treading them with their feet in a pit.

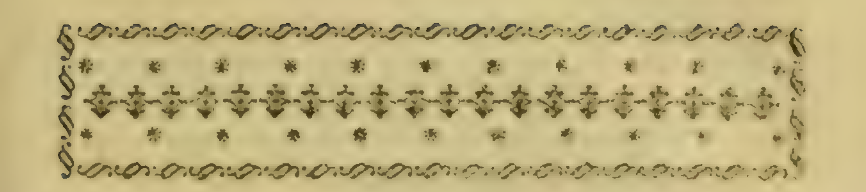
With reſpect to the herb which Job calls borith, I imagine it is ſalworth.

This

This plant is very common in Syria, Judea, Egypt, and Arabia. They burn it, and pour water upon the ashes. This water becomes impregnated with a very strong lixivial salt, proper for taking stains or impurities out of wool or cloth.

The Greeks and Romans used several kinds of earths and plants instead of soap. The Savages of America make a kind of soap-water of certain fruits, with which they wash their cotton-beds and other stuffs. In Iceland the women make a ley of ashes and urine. The Persians employ boles and marls. In many countries they find earths, which, dissolved in water, have the property of cleaning and whitening cloth and linen. All these methods might perhaps be practised in the primitive ages. The necessities of all mankind are much the same, and all climates present them with nearly the same resources. It is the art of applying them, which distinguishes polite and civilized nations from Savages and Barbarians.

THE



THE

DYER's ASSISTANT.

CHAP. I.

Of B L U E.

WOOL and woollen ſtuffs of all kinds, are dyed blue without any other preparation than wetting them well in luke-warm water, ſqueezing them well afterwards, or letting them drain: this precaution is neceſſary, that the colour may the more eaſily inſinuate itſelf into the body of the wool, that it may be equally diſperſed throughout; nor is this to be omitted in any kind of colours, whether the ſubject be wool or cloth.

As to wool in the fleece, which is uſed in manufacturing cloth, as well the mixt as other ſorts, and which they are obliged to dye before they are ſpun, they are prepared in another manner, viz. They are ſcoured, and thereby diveſted of the

natural fat they had when on the body of the animal.* As this operation is properly the Dyer's, and is indiſpenſable in wool which is to be dyed before it is ſpun, let the colour be what it will, I ſhall give the proper proceſs:

This operation is not every where alike, but this is the method followed in the manufactory of Audly in Normandy, where cloths are moſt beautifully manufactured:

A copper containing twenty pails is uſed for this purpoſe; they put twelve pails of water, and four of urine, (which is generally fermented) the copper is heated, and when the liquor is ſo hot as to bear the hand without ſcalding, ten or twelve pounds of wool, that ſtill contains its natural fat, are put in and left in the copper about a quarter of an hour, ſtirring from time to time with ſticks; it is then taken out and put to drain on a ſcray; from thence it is carried in a large ſquare baſket, and placed in running water, two men ſtirring it to and fro for a conſiderable time with long poles, till it is entirely cleanſed of its fat; then it is taken out and placed in a baſket to drain: while this wool is thus preparing, a like quantity may be put into the copper, and thus proceed till the whole is ſcoured. If the liquor is too much waſted, freſh is to be added, made up of one part urine and three parts water. They generally ſcour a bale of wool at once; if it weighed 250lb. in the fat, it generally loſes 60lb. in ſcouring; but this diminution of weight varies in proportion to the wool being more or leſs ſcoured, and in proportion to the more or leſs fat contained therein. Too much attention cannot be paid to the ſcouring, as it is thereby better diſpoſed for the reception of the dye.

The

* The natural fat adhering to the wool preſerves it in the warehouſe, and alſo from moths.

The fat, which is an oily tranſudation, and ſlightly partaking of the quality of urine retained by the fleece, which is too thick to let it out, is ſoluble in water, conſequently, as water alone could not ſeparate it, a fourth part of urine is put into the copper, which muſt have been kept ſome days, in order to ſeparate its volatile ſalts by fermentation; (I mean that it is neceſſary this urine ſhould begin to acquire a ſtrong ſmell) this volatile ſalt, being an alkali, forms with the fat a kind of ſoap, which is always the reſult of all oils and alkalis whatſoever mixed together. As ſoon as ſoap is formed by the combination of theſe two principles, it becomes ſoluble in water, and is conſequently eaſily carried off. A proof that a true ſoap has been formed in this operation, is, that the water which carries it away, whitens as long as any fat is ſeparated from the wool: if there was a ſufficient quantity of fermented urine in the copper, the wool will be well ſcoured; if it was not, all the fat would not be changed into ſoap, and conſequently the wool will remain greaſy. The ſame operation might be performed with fixed alkalis, as with the lee of pot-aſh or pearl-aſhes: but as this lee would not only come dearer than urine, it might alſo damage the wool, if the exact proportion was not applied. I am convinced by ſeveral experiments, that theſe cauſtic ſalts do eaſily deſtroy all animal ſubſtances, as wool, ſilk, &c.

I beg the reader may take notice, that tho' in the ſequel I do not mention this operation of ſcouring, 'tis nevertheleſs neceſſary for all wool that is to be dyed before it is ſpun, as alſo that it is neceſſary to wet thoſe that are ſpun, and ſtuffs of all kinds, that the colour may be the more equally diffuſed throughout.

Of the five primary colours mentioned in the Preface, two of them require a preparation given by noncolouring ingredients, which, by the acidity and fineneſs of their earth, diſpoſe the pores of the wool to receive the colour. This is called the preparation; it varies according to the nature of ſhades and colours: the red, the yellow, and the colours derived from them muſt be ſo treated; black muſt have a preparation peculiar to itſelf; blue and brown require none; it is ſufficient that the wool be thoroughly ſcoured and wetted; and even for blue, it ſuffices to dip it into the vat, ſtirring it well, and letting it remain, more or leſs, according as the ground of the colour is wanted. For this reaſon, and alſo that many colours previouſly require a blue ſhade to be given to the wool, I ſhall begin with it, and give thereon the moſt exact rules in my power. It is an eaſy matter to dye wool blue, when the vat is once prepared, but it is not ſo eaſy to prepare the vat, which is the moſt difficult part of the Dyer's art. In all the other proceſſes, it is ſufficient to follow the ſimple operations tranſmitted from maſters to apprentices. Three ingredients are uſed in the blue dye, viz. Garden-woad or paſtel, the woad, and the indigo. I ſhall give the preparation of each, beginning with the garden-woad.

C H A P. II.

Of the GARDEN-WOAD, *or* PASTEL-VAT.

THE garden-woad is a plant cultivated in many parts of Holland and France, and might be in England or Ireland, to the great advantage of the inhabitants: it is made up in balls,

green

generally weighing from one hundred and fifty pounds to two hundred; it resembles little clods of dried earth, interwoven with the fibres of plants, it is gathered at a proper season, and laid up to rot, and then made into small balls to dry. Several circumstances are to be observed in its preparation; on this you may see the regulations of Monf. Colbert on Dyes; the best prepared comes from the diocese of Alby in France.

The Vat set to Work.

A copper, as near as possible to the vat, is filled with water that has stood some time, or, if such water is not at hand, a handful of Dyer's woad or hay is added to the water, with eight pounds of crust of fat madder. If the old liquor from a vat that has been used in dying from madder can be procured, it will save the madder, and produce a better effect.

The copper being filled, and the fire lighted about three in the morning, it must boil an hour and a quarter (some Dyers boil it from two hours and a half to three); it is then conveyed by a spout into the woad vat, in which has been previously put a peck of wheaten bran. Whilst the boiling liquor is emptying into the vat, the balls of woad must be put one after the other into the vat, that they may be the easier broken, raked, and stirred; this is to be continued till all the hot liquor from the copper is run into the vat, which, when little more than half full, must be covered with cloths somewhat larger than its circumference, so that it may be covered as close as possible, and left in this state for four hours. Then it must be aired, that is, uncovered to be raked, and fresh air let into it; and to each bale of woad a good measure of ware

flung in; this is a concealed name for lime that has been flacked. This meaſure is a kind of wooden ſhovel, which ſerves to meaſure the lime groſsly; it is five inches broad and three inches and a half long, containing near a good handful; the lime being ſcattered in, and the vat well raked, it muſt be again covered, leaving a little ſpace of about four fingers open, to let in air. Four hours after, ſhe muſt be raked, without ſerving her with lime; the cover is then put on, leaving, as before, an opening for the air; in this manner ſhe muſt be let to ſtand for two or three hours. Then ſhe may be raked well again, if ſhe is not yet come to work; that is, if ſhe does not caſt blue at her ſurface, and that ſhe works or ferments ſtill, which may be known by raking and plunging with the flat of the rake in the vat; being well raked, ſhe is to remain ſtill for one hour and a half more, carefully obſerving whether ſhe caſts blue. She is then to be ſerved with water, and the quantity of indigo judged neceſſary is to be put in: it is commonly uſed in a liquid ſtate, the full of a dye-houſe kettle for each bale of woad; the vat being filled within ſix finger-breadths of her brim, is to be raked and covered as before; an hour after filling her with water, ſhe muſt be ſerved with lime, viz. Two meaſures of lime for each bale of woad, giving more or leſs according to the quality of the woad, and what may be judged it will ſpend or take of lime.

I hope the reader will excuſe my plainneſs; this treatiſe being wrote for the Dyer, I muſt ſpeak the language he is uſed to; the Philoſopher will eaſily ſubſtitute proper terms, which perhaps the workman would not underſtand. There are kinds of woad readier prepared than others, ſo that general and preciſe rules cannot be given on this head. It

muſt

must also be remarked, that the lime is not to be put into the vat till ſhe has been well raked.

The vat being again covered, three hours after a pattern muſt be put in, and kept entirely covered for an hour; it is then taken out to judge if ſhe be fit to work. If ſhe is, the pattern muſt come out green, and on being expoſed a minute to the air, acquire a blue colour. If the vat gives a good green to the pattern, ſhe muſt be raked, ſerved with one or two meaſures of lime, and covered.

Three hours after, ſhe muſt be raked, and ſerved with what lime may be judged neceſſary; ſhe is then to be covered, and one hour and a half after, the vat being pitched or ſettled, a pattern is put in, which muſt remain an hour to ſee the effects of the woad. If the pattern is of a fine green, and that it turns to a deep blue in the air, another muſt be dipt in to be certain of the effect of the vat. If this pattern is deep enough in colour, let the vat be filled up with hot water, or, if at hand, with old liquor of madder, and rake her well. Should the vat ſtill want lime, ſerve her with ſuch a quantity as you may judge ſufficient by the ſmell and handling. This done, ſhe muſt be again covered, and one hour after put in your ſtuffs, and make your overture. This is the term uſed for the firſt working of wool or ſtuffs in a new vat.

Marks by which you may know how to conduct a Vat regularly.

A vat is fit to work when the grounds are of a green brown, when it changes, on its being taken out of the vat, when the flurry is of a fine Turkiſh or deep blue, and when the pattern, which has been dipt in it for an hour, comes out of a fine deep graſs green. When ſhe is fit to work, the

bever

bever has a good appearance, clear and reddiſh, and the drops and edges that are formed under the rake in lifting up the bever are brown. Examining the appearance of the bever, is lifting up the liquor with the hand or rake, to ſee what colour the liquor of the vat has under its ſurface. The ſediment or grounds muſt change colour (as has been already obſerved) at being taken out of the bever, and muſt grow brown by being expoſed to the external air. The bever or liquor muſt feel neither too rough nor too greaſy, and muſt not ſmell either of lime or lee. These are the diſtinguiſhing marks of a vat that is fit to work.

How to know when a Vat is cracked by too great or too ſmall a Quantity of Lime; Extremes which muſt be avoided.

When more lime has been put in than was ſufficient for the woad, it is eaſily perceived by dipping in a pattern, which inſtead of turning to a beautiful graſs green, is only daubed with a ſteely green. The grounds do not change, the vat gives ſcarcely any flurry, and the bever has a ſtrong odor of quick lime, or its lees.

This error is rectified by thinning the vat, in which the Dyers differ; ſome uſe tartar, others bran, of which they throw a buſhel into the vat, more or leſs in proportion to the quantity of lime uſed, others a pail of urine. In ſome places a large iron chafing-diſh is made uſe of, long enough to reach from the ground to the top of the vat, this chafing-diſh or furnace has a grate at a foot diſtance from its bottom, and a funnel coming from under this grate, and aſcending to the top of the chafing-diſh, which is to give air to, and kindle the coals which are placed on the grate. This furnace is ſunk

ſunk in the vat, near to the ſurface of the grounds, ſo as not to touch them, and is faſtened with iron bars to prevent its riſing. By this method the lime is raiſed to the ſurface of the liquor, which gives an opportunity to take off with a ſieve what is thought ſuperfluous; but when this is taken out, the neceſſary quantity of ware muſt be carefully reſtored to the vat. Others again thin the vat with pearl aſhes, or tartar boiled in ſtale urine; but the beſt cure, when ſhe is too hard, is, to put in bran and madder at diſcretion; and if ſhe be but a little too hard, it will ſuffice to let her remain quiet four, five, or ſix hours, or more, putting in only two hats full of bran and three or four pounds of madder, which are to be lightly ſtrewed on the vat, after which it is to be covered. Four or five hours after, ſhe is to be raked and plunged, and according to the colour, that the flurry which ariſes from this motion, aſſumes and imprints on the whole liquor, a freſh proof is made by putting in a pattern.

If ſhe is cracked, and caſts blue only when ſhe is cold, ſhe muſt be left undiſturbed, ſometimes whole days without raking; when ſhe begins to ſtrike a tolerable pattern, her liquor muſt be reheated or warmed; then commonly, the lime, which ſeemed to have loſt all power to excite a fermentation, acquires new ſtrength, and prevents the vat from yielding its dye ſo ſoon. If ſhe is to be haſtened, ſome bran and madder are to be thrown on, as alſo one or two baſkets of new woad, which helps the liquor that has been reheated to ſpend its lime.

Care muſt be taken to put patterns in each hour, in order to judge, by the green colour which they acquire, how the lime is worked on. By theſe means ſhe may be conducted with more exactneſs, for

for when once a vat is cracked, by too great or too ſmall a quantity of lime, ſhe is brought to bear with much more difficulty. If while you are endeavouring to bring her to work, the bever grows a little too cold, it muſt be heated by taking off ſome of the clear, and inſtead thereof, adding ſome warm water; for when the bever is cold, the woad ſpends little or no lime; when it is too hot, it retards the action of the woad, and prevents it from ſpending the lime; therefore it is better to wait a little, than to haſten the vats to come to work when they are cracked. A vat is known not to have been ſufficiently ſerved with lime, and that ſhe is cracked, when the bever gives no flurry, but inſtead thereof gives only a ſcum, and when ſhe is plunged or raked, ſhe only works, ferments and hiſſes, (this noiſe is made by a great number of air bubbles that burſt as ſoon as they form) the liquor has alſo the ſmell of a common ſewer or ſink, or rotten eggs; it is harſh and dry to the touch: the grounds when taken out do not change, which generally happens when a vat is cracked for want of lime. This accident is chiefly to be apprehended when a vat is opened and a dip made in her, for if her ſtate has not been looked into, both in regard to the ſmell as well as raking and plunging, and that the ſtuffs be imprudently put in when the woad has ſpent its lime, it is to be feared the vat may be loſt; for the ſtuffs being put in, the ſmall quantity of lime that ſtill remains in a ſtate to act, ſticks to them, the bever is diveſted of it, and the ſtuffs only blotted; theſe muſt be immediately taken out, and a quick remedy applied to the vat, to preſerve the remaining part of the dye, which is done by putting in three or four meaſures of lime, more or leſs, according as the vat is cracked, and that without raking her bottom.

It

It is alſo to be obſerved, that if in raking and plunging the fermentation ceaſes, and the bad ſmell change, it is then to be ſuppoſed that the bever or liquor alone has ſuffered, and that the grounds are not yet in want. When the fermentation is in part or totally abated, and the bever has a ſmell of lime, and feels ſoft to the touch, the vat is to be covered and left at reſt; and if the flurry ſtill remains on the vat an hour and a half, a pattern is to be put in, which muſt be taken out one hour after, and you are to be guided according to the green ground it will take. But generally vats that are thus cracked, are not ſo ſoon brought to a ſtate fit for dying.

The Opening of the Vat.

The vat being come to work, the croſs muſt be let down, and about thirty ells of cloth, or the equivalent of its weight of wool well ſcoured, (which is firſt intended to be dyed of a Perſian blue to make a black afterwards) having returned this ſtirring ſeveral times, which muſt have always been covered with the liquor, the cloth muſt be twiſted on the rings faſtened to the jack at the top of the vat; if it be wool, it is to be dipt with a net, which will ſerve to wring it: the cloth muſt be opened by its liſts to air it, and to cool the green, that is, to make it loſe the green colour it had coming out of the vat, and take the blue. If this cloth or wool was not deep enough for a mazarine blue by the firſt dipping, it muſt get another, by returning into the vat the end of the piece of c oth which firſt came out; and according to the ſtrength of the woad, you muſt give to this ſtriking two or three returns, as may be thought neceſſary for the intenſity of the blue required. If the woad be good, ſuch

ſuch as the true l'auragais is commonly, after taking out the firſt ſtirring, a ſecond may be put in at this firſt opening of the vat. After making this opening, which is alſo called the firſt raking, the vat is to be again raked, and ſerved with lime at diſcretion, obſerving that it has the ſmell and touch conformable to what has been laid down before, and taking notice, that in proportion as the dye diminiſhes, ſo does the ſtrength of the woad.

If the vat be in good order at the firſt opening, three or four ſtirrings may be made, and the next day, two or three more, only obſerving not to hurry her, or to work her as ſtrong as at firſt. That the vat may turn to as much profit as poſſible, for the ſhades of blue; firſt, all ſtuffs intended to be black, are dyed; then the king's blue; after theſe the green brown: the violets and Turkiſh blues are commonly done in the laſt rakings of the ſecond day of the opening. The third day, if the vat appears much diminiſhed, ſhe muſt be filled with hot water within four inches of the brim. This is called filling the vat.

The latter end of the week, the light blues are made, and on Saturday night, having raked the vat, ſhe is to be ſerved a little more than the preceding day, that ſhe may keep till Monday.

Monday morning the bever is put on the fire, by paſſing it from the vat into the copper by a trough, which reſts on both; this clear bever is emptied to the grounds, and when it is ready to boil it muſt be returned into the vat, raking the grounds, as the hot liquor falls from the trough; at the ſame time may be added a kettleful of prepared indigo.

When the vat is filled within four inches of the brim, and well raked, ſhe muſt be covered, and two hours after a pattern put in, which muſt remain

main not more than an hour; lime must be added according to the shade of the green, which this proof pattern shall have taken, and at the expiration of an hour or two, if the vat has not suffered, the stuff is to be put in; having conducted it between two waters for about half an hour, it is wrung, and a dip is again given to it, as was done in the new vat. This vat heated again, is conducted in the same manner, that is, three rakings are made the first day, observing at each raking, whether she wants lime; for in this case, the quantity judged necessary must be given.

Blue made of woad alone, according to the opinion of some persons prejudiced in the favour of old customs, is much better than that which the woad gives with the addition of indigo. But then this blue would be much dearer, because woad gives much less dye than indigo, and it has been found by repeated experience, that four pounds of fine indigo from Guatimala, produced as much as a bale of Albigeois woad or pastel; and five pounds as much as a bale from L'Auragais, which generally weighs two hundred and ten pounds. So the using of the indigo with the woad is a great saving, as one vat with indigo shall dye as much as three without it.

Indigo is generally put into new vats after the woad yields its blue, and a quarter or half after she is to be served with lime; as this solution of indigo is already impregnated with some of its dissolution, the lime must be given with a more sparing hand than where the woad is used alone. At the re-heating, the indigo is put in on Saturday night, that it may incorporate with the bever, and that it may serve as garnish by its lime. The indigo that is brought from Guatimala in America is the best; it is brought over in the shape of small stones, and

of a deep blue; it muſt be of a deep violet colour within, and when rubbed on the nail, have a copper hue; the lighteſt is the beſt. It is neceſſary to obſerve, that for the better conducting of a woad vat, and to prevent accidents, a manufacturer ought to have a good woadman, this is the name given to the Journeyman Dyer, whoſe principal buſineſs is to conduct the woad, practice has taught him more than this treatiſe can furniſh.

I ſhall make ſome reflections neceſſary to attain a more perfect knowledge of this proceſs. The woad vat muſt never be re-heated but when fit for working; that is, ſhe muſt have neither too much nor too little lime, but be in ſuch a ſtate as only to want heating to come to work. It is known ſhe has too much lime (as has been before obſerved) by the quick ſmell; on the contrary, a want is known by the ſweetiſh ſmell, and by the ſcum which riſes on the ſurface by raking, being of a pale blue.

Care muſt be taken when a vat is intended to be re-heated, not to ſerve her with lime in the evening, (unleſs in great want of it) for if ſhe was too much ſerved with it, ſhe might next day be too hard, as the Dyers term it; for by heating her again, a greater action is given to the lime, and makes her ſpend it the quicker. Freſh indigo is commonly put into the vat, each time ſhe is re-heated, in proportion to the quantity to be dyed. It would be needleſs to put in any, if there was but little work to do, or only light colours wanted. It was not permitted by the ancient regulations of France, to put more than ſix pounds of indigo to each bale of woad, becauſe the colour of the indigo was thought not laſting, and that it was only the great quantity of woad which could ſecure and render it good; but it is now aſcertained, both by the experiments of Monſieur Dufay, and thoſe which I have ſince made,

made, that the colour of indigo, even uſed alone, is full as good, and reſiſts as much the action of the air, ſun, and rain, as that of paſtel or woad.

When a vat has been heated two or three times, and a good part has been worked off, the ſame liquor is often preſerved, but part of the grounds are taken out, which is replaced by new woad; (this is called vamping); the quantity cannot be preſcribed on this occaſion, for it depends upon the work the Dyer has to do. Practice will teach all that can be wiſhed for on this head. There are Dyers who preſerve liquor in their vats ſeveral years, renewing them with woad and indigo in proportion as they work them; others empty the vat entirely, and change the liquor when the vat has been heated ſix or ſeven times, and that ſhe gives no more dye. A ſeries of practice alone will ſhew which of theſe is preferable. It is however more reaſonable to think, that by renewing it now and then, more lively and beautiful colours may be obtained, and the beſt Dyers follow this method.

In Holland they have vats which do not require to be ſo often heated. Mr. Van Robbais had ſome of theſe made ſome years ſince for their royal manufactory at Abbeville. The upper parts of theſe vats, to the height of three feet, are of copper, and the reſt lead: They are alſo ſurrounded with a ſmall brick wall, at ſeven or eight inches from the copper; in this interval embers are put, which keep up the heat of the vat a long time, ſo that ſhe remains ſeveral days together in a condition to be worked, without the trouble of heating her over again. Theſe vats are much more coſtly than the others, but they are very convenient, eſpecially for the dipping of very light colours; becauſe the vat is always fit to work, though ſhe be very weak; this is not the caſe of the others, which generally

make the colour a great deal deeper than required, unless they are set to cool considerably, and then it happens that the colour is not so good, nor has it the same brightness. To make these light colours in common vats, it is better to work some purposely that are strong with woad and weak of indigo; such give their colours slower, and light colours are made with greater ease.

As to the vats made after the Dutch fashion, and which have already been mentioned, the four which Mr. Van Robbais has in his manufactory, are six feet in depth, of which three feet and a half in the upper part are copper, and the two feet and a half of the bottom are lead. The diameter at the bottom is four feet and a half, and that at the top five feet four inches.

To return to the observations on heating the common vats. If the vat was heated when crackt, that is, when she has not quite lime enough, she would turn in the heating without being perceived, and perchance be entirely lost, as the heat would soon finish the spending of the lime, which was in too small a quantity. If this is perceived in time, it must be helped by pouring it back into the vat without more heating; then feed her with lime, and not heat her till she is come to work.

On the re-heating, some of the grounds must be put into the copper with the liquor or bever; and great care must be taken not to boil it, because the volatile necessary in this operation would evaporate. There are some Dyers, who, in heating their vats, do not put in the indigo immediately after the liquor is poured from the copper into the vat, but wait some hours till they see her come to work: this they do as a precaution, lest the vat should fail, and the indigo be lost; but by this method, the indigo does not so freely yield its colour, as they are obliged

obliged to work her as ſoon as ſhe is fit, that ſhe may not cool, ſo that the indigo, not being entirely diſſolved, nor altogether incorporated, has no effect. It is therefore better to put it into the vat at the ſame time the liquor is caſt in, and rake her well after. If the vat is heated over again without her coming to work, ſhe muſt not be ſcummed as in the common heatings, as the indigo would be carried off thereby, whereas, when ſhe has worked, this ſcum is formed of the earthy part of the indigo and woad, united with a portion of lime.

When too much lime is put into a vat, you muſt wait for her till ſuch time as ſhe has ſpent it, or it may be accelerated by heating it, or by putting in ingredients which deſtroy in part the action of the lime, ſuch as tartar, vinegar, honey, bran, ſome mineral acid, or any matter that will become ſour; but all theſe correctors wear out the dye of the indigo and woad, ſo that the beſt method is, to let it ſpend of its own accord. A vat is not commonly fed with lime, but on the firſt, ſecond, and ſometimes the third day, and it is alſo remarked, not to dip the violets, purples, or any other wool or ſtuffs which have previouſly a colour that may be eaſily damaged, the ſucceeding day after its being fed with lime, as it is then too active, it dulls the firſt colour; the fifth or ſixth day the crimſon may be dipt to give them a violet, and the yellows for green; following this rule, the colours will always be bright.

When a vat has been re-heated, ſhe muſt come to work before ſhe is ſerved with lime; if this was done a little too ſoon, ſhe would be cracked; the ſame thing would happen if ſome of the grounds were put into the copper. The moſt effectual method in this caſe is to let her reſt before ſhe is worked, until ſhe comes to, which often happens in two, three, or four hours, and ſometimes a day.

By uſing light or weak lime, ſhe grows too hard; becauſe this light lime remains in the liquor, and does not incorporate with the grounds. This is known by the ſtrong ſmell of the liquor, and on the contrary the grounds have a ſweetiſh ſmell, whereas the ſmell ought to be equal in both. The beſt way then is, to let it ſpend itſelf, by raking her often, in order to mix the lime with the grounds, until the ſmell of the vat is reſtored, and the flurry becomes blue.

A woad vat may be ſet without the addition of indigo, but then ſhe yields but little colour, and only dyes a ſmall quantity of wool or ſtuffs; for one pound of indigo, as has already been obſerved, affords as much dye as fifteen or ſixteen pounds of woad. I ſet one of this kind to try the qualities of woad by itſelf, and I could not find that indigo was any way inferior to it, either for the beauty or ſolidity of the colour. As lime is always uſed, and ſometimes ſour liquors, in the ſetting of a vat, this is the proper place to ſpeak of their preparation.

Preparation of Lime.

That the lime may be properly ſlacked for the Dyer's uſe, ſeveral pieces are immerſed in water, one after another, and when each has remained till it begins to crackle, they are taken out to put in others, and after this manner they are caſt into an empty veſſel, where the lime finiſhes ſlacking, and reduces itſelf to powder, conſiderably augmenting its bulk; it is afterwards ſifted through a canvaſs, and kept in a dry hogſhead.

Sour liquors are not only neceſſary in ſome circumſtances of ſetting a woad vat, but alſo in ſome of the preparations given to wool and ſtuffs previous

vious to their being dyed; they are prepared after the following manner.

Preparation of ſour Liquors.

A copper of the ſize required is filled with river water, and when it boils, it is flung into a hogshead, where a ſufficient quantity of bran has been put, and ſtirred with a ſtick three or four times a-day. The proportion of bran and water is not very material; I have made a good liquor by putting three buſhels of bran into a veſſel containing two hundred and fourſcore quarts. Four or five days after, this water becomes ſour, and conſequently fit for uſe in all caſes, where it will not be detrimental to the preparations of wool that are independent of dying.

For it may happen, that wool in the fleece which has been dyed in a liquor where too great a quantity of ſour water has been put, will be harder to ſpin, as the ſediment of the bran forms a ſort of ſtarch that glues the fibres of the wool, and prevents their forming an even thread. I muſt here take notice of the bad cuſtom of letting ſour liquors remain in copper-veſſels, as I have ſeen in ſome eminent dye-houſes; for this liquor being an acid, corrodes the copper, and if it remains long enough to take in a portion of this metal, it will cauſe a defect both in the dye and in the quality of the ſtuff: in the dye, becauſe the diſſolved copper gives a greeniſh caſt; in the quality of the ſtuff, becauſe the copper diſſolved preys on all animal ſubſtances. The Dyers are often ignorant of the cauſe of theſe defects.

I flatter myſelf to have omitted no eſſential point on the woad vat: if any difficulties or accidents, which I have mentioned, are not found in the practice,

tice they are not confiderable, and an eafy remedy will be found by thofe who make themfelves familiar with the working part.

The readers who have no idea of this work, may think me too prolix, and find repetitions; but thofe who intend to make ufe of what I have taught in this chapter, will perhaps reproach me for not having faid enough on the fubject.

Thofe that read this chapter with attention, will not be furprized that the mafter-piece for apprentices to Dyers of the great dye, is, to fet the woad vat and work her.

CHAP. III.

Of the FIELD WOAD VAT.

I Have but little to fay on this woad vat, different from that which has been related of the paftel or garden woad. The woad is a plant cultivated in Normandy, and prepared after the fame manner the garden woad is in Languedoc. The method of cultivating it may be feen in the French "General Inftructions on Dyes," of the 28th of March, 1671, from the article 259 to 288, where it treats of the culture and preparation of the paftel and woad. The woad vat is fet at work after the fame manner as that of paftel; all the difference is that it has lefs ftrength and yields lefs dye. There follows a defcription of the woad vat, which I carried on in fmall, and in a bath heat fimilar to that of the paftel in the foregoing chapter.

I placed in a copper a fmall veffel containing fifty quarts, and filled two-thirds with a liquor made of river water, one ounce of madder, and a little weld, putting in at the fame time a good handful

handful of wheaten bran and five pounds of woad. The vat was well raked and covered; it was then five in the evening; it was again raked at seven, nine, twelve, two, and four o'clock; the woad was then working, that is, the vat was slowly coming to work, as I have already related of that of the pastel.

Pretty large air bubbles formed themselves, but in a small quantity, and had scarcely any colour. She was then served with two ounces of lime and raked. At five o'clock a pattern was put in; which was taken out at six, raking her; this pattern began to have some colour; another was put in at seven, at eight she was raked, and the pattern came out pretty bright; an ounce of indigo was then put in; at nine another pattern, at ten she was raked, and one ounce of lime was added, because she began to have a sweetish smell; at eleven a pattern, at twelve she was raked; it was thus continued till five, then three ounces of indigo were put in, at six a pattern, at seven she was raked. It would then have been proper to have served her with water, as she was at that time perfectly come to work, the pattern that was taken out being very green, and turning of a bright blue. But besides that I was fatigued, having sat up the whole night, I chose rather to put her back to the next day, to see her effect by day-light; and for that purpose, I put one ounce of lime, which kept her up till nine in the morning: from time to time patterns were put in, the last that was taken out was very beautiful; she was served with a liquor composed of water, and a small handful of bran. She was raked, and patterns put in from hour to hour; at five she was come to work; she was afterwards served with lime, and raked to preserve her till she was to be re-heated.

Some

Some time after I ſet another with the woad alone without indigo, that I might be able to judge of the laſting of the dye of the woad, which, upon trial, I found to be as good as the paſtel or garden woad. Thus all the ſuperiority the paſtel has on the woad, is, that the latter yields leſs dye than the former.

The little varieties that may be obſerved in ſetting theſe different vats at work, prove, that there are many circumſtances in theſe proceſſes that are not abſolutely neceſſary. It appears to me, that the only important point, and that to which the greateſt attention is to be given, is, in the conducting the fermentation with care, and not to ſerve her with lime, but when judged neceſſary by the indications I have laid down. As to the indigo being put in at twice, or altogether, a little ſooner or later, it appears very indifferent. The ſame may be ſaid of the weld, which I made uſe of twice, and ſuppreſſed the two other times, and of pearl-aſhes, which I added in a ſmall quantity in the ſmall paſtel vat, and ſuppreſſed in the woad vat. In ſhort, I believe, and it appears to me to a demonſtration, that the greateſt regard is to be had to the proper diſtribution of the lime, throughout the whole courſe of the working of the vats, either to ſet them at work, or to re-heat them. I muſt alſo add, that when a woad vat is ſet to work, ſhe cannot be too often inſpected into to know her ſtate; for if there are ſome that are backward (which is attributed to the weakneſs of the woad) there are alſo others that very quickly come to work. I have ſeen a middling one of ſeventy pounds of woad, poiſoned; becauſe the woad man neglected to inſpect her as often as ſhe required, and ſhe had been two hours fit to work before he diſcovered it; the grounds were entirely come up to the ſurface of the liquor, and the whole had

a very

a very four fmell; it was not poffible to bring her back, and they were obliged to fling her away, as fhe would in a fhort time have contracted a fœtid fmell. The retarding of the action of the vat may alfo proceed from the temperature of the air; for the vat cools a great deal fooner in winter than in fummer; therefore it becomes neceffary to watch it attentively, though commonly they are fourteen or fifteen hours before they come to work.

I fhall endeavour to explain, in the fequel, how the colouring part of this ingredient, fo neceffary in dying, difplays itfelf; but I muft firft of all fpeak of vats which are prepared from indigo.

C H A P. IV.

The INDIGO VAT.

Procefs of making the INDIGO *in* AMERICA.

INDIGO is the fecula of a plant named *nil* or *anil*; to make it, three vats are placed the one over the other, in form of a cafcade; in the firft, called the fleeper, the plant is put in with its leaves, bark, and flowers *, and filled with water; fome time after, the whole ferments, the water grows intenfely hot, thickens, and becomes of a blue colour, bordering on the violet; the plant, according to the opinion of fome, depofing all its falts, and, according to others, all its fubftance. In this ftate, the cocks of the fleeper are turned, and all the water let out ftained with the colouring

* In the village of Sarguffa, near the town of Amadabat, the Indians only ufe the leaves of the anil; they fling away the reft of the plant. The beft indigo comes from thence.

parts

parts of the plant into the ſecond, called the beater; becauſe this water is beat by a mill or machine that has long ſticks, to condenſe the ſubſtance of the indigo, and precipitate it to the bottom. By this means the water becomes clear and colourleſs, like common water; then the cocks are turned, that the water may run off from the ſurface of the blue ſediment; after which, other cocks are turned that are at the bottom, that all the fecula may fall into the third vat, called the repoſer; for it is there the indigo remains to dry; it is then taken out to be made into cakes, &c. See, on this ſubject, *Hiſtoire des Antilles, pare le Pere Labat.*

At Pondicherry, on the coaſt of Coromandel, there are two kinds of indigo, the one a great deal finer than the other; the beſt is ſeldom uſed but to luſtre their ſilks, the inferior in dying. They augment in price according to their quality; there is ſome which coſt from 15 pagodas the bar (which weighs 48 pounds) to 200 pagodas. The moſt beautiful is prepared nigh Agra. There is alſo a very good kind that comes from Maſulipatan and Ayanon, where the Eaſt-India Company have a factory. At Chandernagor it is called nill when it is prepared and cut to pieces. The indigo of Java is the beſt of all; it is alſo the deareſt, and conſequently few Dyers uſe it. Good indigo ought to be ſo light as to float on the water; the more it ſinks, the more it may be ſuſpected of being adulterated by a mixture of earth, cinders, or pounded ſlates. It muſt be of a deep blue, bordering on the violet, brilliant, lively, and ſhining; it muſt be finer within, and appear of a ſhining hue. Its goodneſs is tried by diſſolving it in a glaſs of water; if it be unmixed and well prepared, it will diſſolve entirely; if ſophiſticated, the foreign matter will ſink to the bottom. Another method of trying

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it is by burning; good indigo burns entirely away, and when adulterated, the mixture remains after the indigo is consumed.

Powdered indigo is much more subject to adulteration than that which is in cakes; for it is a difficult matter that sand, powdered slates, &c. should unite so as not to form together in different places layers of different matters; and, in this case, by breaking the lump indigo, it is easily discovered.

Method of working the Indigo Vat.

There are several methods of preparing the indigo vat; I tried all those I knew, and they all succeeded. I shall describe them after the most exact manner, beginning with that which is the most in use, and almost the only one known at Paris.

It is a vat which is about five feet in height, two feet diameter, and becomes narrow towards the bottom; she is surrounded with a wall that leaves a space round her, which serves to hold embers. In a vat of this size, two pounds of indigo may at least be used, and five or six for the greatest proportion. To set a vat of two pounds of indigo in such a vessel that may contain about fourscore quarts, about sixty quarts of river water are set to boil in a copper for the space of half an hour, with two pounds of pearl ashes, two ounces of madder, and a handful of bran; during this, the indigo is prepared after the following manner:

Two pounds of it are weighed out, and cast into a pail of cold water to separate the earthy parts. The water is afterwards poured off by inclination, and the indigo well ground; a little warm water is put into it, shaking it from side to side; it is poured by inclination into another vessel; what remains is still ground, and fresh water put

in to carry off the fineſt parts, and thus continued till all the indigo is reduced into a powder, fine enough to be raiſed by the water. This is all the preparation it undergoes. Then the liquor which has boiled in the copper with the grounds are poured into the high and narrow vat, as likewiſe the indigo; the whole is then raked with a ſmall rake, the vat is covered, and embers placed round her. If this work was begun in the afternoon, a few embers are added at night; the ſame is repeated the next day morning and night. The vat is alſo lightly raked twice the ſecond day; the third day, the embers are continued to be put round, to keep up the heat of the vat; ſhe is raked twice in the day: about this time, a ſhining copper-coloured ſkin begins to appear on the ſurface of the liquor, and appears as if it was broken or cracked in ſeveral places. The fourth day, by continuing the fire, this ſkin or pelicle is more formed and cloſer; the flurry, which riſes in raking the vat, appears, and the liquor becomes of a deep green.

When the liquor is in this ſtate, it is a ſign that it is time to fill the vat. For this purpoſe a freſh liquor is made, by putting into a copper about twenty quarts of water, with one pound of pearl aſhes, a handful of bran, and half an ounce of madder. This is boiled a quarter of an hour, and the vat is ſerved with it; ſhe is then raked, and cauſes a great quantity of flurry to riſe, and the vat comes to work the next day; this is known by the quantity of flurry with which ſhe is covered by the ſkin or copper-ſcaly cruſt which ſwims on the liquor, which, although it appears of a blue-brown, is nevertheleſs green underneath.

This vat was much longer coming to its colour than the others, becauſe the fire was too ſtrong the ſecond day, otherwiſe ſhe would have been fit

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to work two days fooner. This did no other damage but retarded her, and the day fhe came to work, we dipt in ferges weighing thirteen or fourteen pounds. As this caufed her to lofe her ftrength, and the liquor being diminifhed by the pieces of ftuff that had been dyed in her, fhe was ferved in the afternoon with frefh liquor, made with one pound of pearl afhes, half an ounce of madder, and a handful of bran; the whole was boiled together in a copper for a quarter of an hour; the vat being ferved with it fhe was raked, covered, and a few embers put round. She may be preferved after this manner feveral days, and when fhe is wanted to work, fhe muft be raked over night, and a little fire placed about her.

When there is occafion to re-heat, and add indigo to this kind of vat, two thirds of the liquor (which then is no more green, but of a blue-brown and almoft black) is put into a copper; when it is ready to boil, all the fcum that is formed at the top is taken off with a fieve; it is afterwards made to boil, and two handfuls of bran, a quarter of a pound of madder, and two pounds of pearl afhes are added. The fire is then removed from the copper, and a little cold water caft into it to ftop the boil; after which the whole is put into the vat, with one pound of powdered indigo, diluted in a portion of the liquor as before related; after this the vat is raked, covered, and fome fire put round; the next day fhe is fit to work.

When the indigo vat has been re-heated feveral times, it is neceffary to empty her entirely, and to fet a frefh one, or fhe will not give a lively dye; when fhe is too old and ftale, the liquor is not of fo fine a green as at firft.

I put feveral other vats to work after the fame method, with different quantities of indigo, from

one pound to ſix; always obſerving to augment or diminiſh the other ingredients in proportion, but always one pound of pearl aſhes to each pound of indigo. I have ſince made other experiments, which proved to me that this proportion was not abſolutely neceſſary; and I make no doubt but that ſeveral other means might be found to make the indigo come to as perfect a colour. I ſhall, nevertheleſs, proceed to ſome other obſervations on this vat.

Of all thoſe I ſet to work, after the manner deſcribed, one only failed me, and that by neglecting to put fire round her the ſecond day. She never came to a proper colour; powdered arſnic was put in to no effect; red-hot bricks were alſo plunged in at different times; the liquor turned of a greeniſh hue, but never came to the proper colour; and having attempted ſeveral other means without ſucceſs, or without being able to find out the cauſe of her not ſucceeding, I cauſed the liquor to be emptied and caſt away.

All the other accidents that have happened me in conducting the indigo vat, have only lengthened the operation; ſo that this proceſs may be looked upon as very eaſy when compared to that of the woad vat. I have alſo made ſeveral experiments on both, in which my chief view was to ſhorten the time of the common preparation; but not meeting with the deſired ſucceſs, I ſhall not relate them.

The liquor of the indigo vat is not exactly like that of the woad; its ſurface is of a blue-brown, covered with coppery ſcales, and the under part of a beautiful green. The ſtuff or wool dyed in this is green when taken out, and becomes blue a moment after.—We have already ſeen that the ſame happens to the ſtuff dyed in the woad vat; but it is remarkable,

remarkable, that the liquor of the laſt is not green, and yet produces on the wool the ſame effect as the other. It muſt alſo be obſerved, that if the liquor of the indigo vat be removed out of the veſſel in which it was contained, and if too long expoſed to the air, it loſes its green and all its quality, ſo that, although it gives a blue colour, that colour is not laſting.

I ſhall examine this more particularly in the ſequel, and endeavour to give the chymical theory of this change.

C H A P. V.

The COLD VAT *with* URINE.

A VAT is alſo prepared with urine, which yields its colour cold, and is worked cold: for this purpoſe four pounds of indigo are powdered, which is to be digeſted on warm aſhes twenty-four hours, in four quarts of vinegar; if it is not then well diſſolved, it muſt be ground again with the liquor, and urine is to be added little by little, with half a pound of madder, which muſt be well diluted by ſtirring the liquor with a ſtick; when this preparation is made, it is poured into a veſſel filled with 250 quarts of urine; it matters not whether it be freſh or ſtale; the whole is well ſtirred and raked together night and morning for eight days, or till the vat appears green at the ſurface when raked, or that ſhe makes flurry as the common vat; ſhe is then fit to work, without more trouble than previouſly raking her two or three hours before. This kind of vat is extremely convenient, for when once ſet to work, ſhe remains good till ſhe be entirely drawn, that is, till the in-

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digo has given all its colour; thus she may be worked at all times, whereas the common vat must be prepared the day before.

This vat may at pleasure be made more or less considerable by augmenting or diminishing the ingredients in proportion to the indigo intended to be made use of; so that to each pound of indigo add a quart of vinegar, two ounces of madder, and sixty or seventy quarts of urine. This vat comes sooner to work in summer than in winter, and may be brought sooner to work by warming some of the liquor without boiling, and returning it into the vat; this process is so simple that it is almost impossible to fail.

When the indigo is quite spent, and gives no more dye, the vat may be charged again without setting a new one. For this purpose, indigo must be dissolved in vinegar, adding madder in proportion to the indigo, pouring the whole into the vat, and raking her night, and morning, and evening as at first, she will be as good as before; however she must not be charged this way above four or five times, for the ground of the madder and indigo would dull the liquor, and in consequence render the colour less bright. I did not try this method, and therefore do not answer for the success; but here follows another with urine which gives a very lasting blue, and which I prepared.

Hot Vat with Urine.

A pound of indigo was steeped twenty-four hours in four quarts of clear urine, and when the urine became very blue, it was run through a fine sieve into a pail, and the indigo which could not pass and which remained in the sieve, was put with four quarts of fresh urine; this was so continued

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till all the indigo had paſſed through the ſieve with the urine; this laſted about two hours. At four in the afternoon three hogſheads of urine were put into the copper, and it was made as hot as could be without boiling. The urine caſt up a thick ſcum, which was taken up with a broom and caſt out of the copper. It was thus ſcummed at different times, till there only remained a white and light ſcum; the urine, by this means ſufficiently purified and ready to boil, was poured into the wooden vat, and the indigo prepared as above put in; the vat was then raked the better to mix the indigo with the urine: ſoon after, a liquor was put into the vat, made of two quarts of urine, a pound of roach-allum, and a pound of red-tartar. To make this liquor, the allum and tartar were firſt put into the mortar, and reduced to a fine powder, upon which the two quarts of urine were poured, and the whole rubbed together, till this mixture, which roſe all of a ſudden, ceaſed to ferment: it was then put into the vat, which was ſtrongly raked: and being covered with its wooden cover, ſhe was left in that ſtate all night; the next morning the liquor was of a very green colour; this was a ſign ſhe was come to work, and that ſhe might have been worked if thought proper, but nothing was dyed in her; for all that was done was only, properly ſpeaking, the firſt preparation of the vat, and the indigo which had been put in was only intended to feed the urine, ſo that to finiſh the preparation the vat was let to reſt for two days, always covered, that ſhe might cool the flower; then a ſecond pound of indigo was prepared, ground with purified urine as before. About four in the afternoon all the liquor of the vat was put into the copper, it was heated as much as poſſible without boiling; ſome thick ſcum formed on it which was taken off, and

and the liquor being ready to boil was returned into the vat. At the ſame time the ground indigo was put in, with a liquor made as above of one pound of allum, one pound of tartar, and two quarts of urine, a freſh pound of madder was alſo added; then the vat was raked, well covered, and left ſo the whole night. The next morning ſhe was come to work, the liquor being very hot, and of a very fine green, ſhe was worked with wool in the fleece, of which thirty pounds were put into the vat. It was well extended and worked between the hands, that the liquor might the more eaſily ſoak into it; then it was left at reſt for an hour or two, according as lighter or deeper blues are required.

All this time the vat was well covered, that it might the better retain its heat, for the hotter ſhe is, the better ſhe dyes, and when cold acts no more. When the wool came to the ſhade of the blue required, it was taken out of the vat in parcels, about the bigneſs of a man's head, twiſted and wrung over the liquor as they were taken out, till from green, as they were coming out of the vat they became blue. This change from green to blue is made in three or four minutes. Theſe thirty pounds being thus dyed, and the green taken off, the vat was raked, and ſuffered to reſt for two hours, being all that time well covered; then thirty pounds more were put in, which was well extended with the hands, the vat was covered, and in four or five hours this wool was dyed at the height or ſhade of the firſt thirty pounds, it was then taken out in heaps, and the green taken off as before. This done, the vat had ſtill ſome little heat, but not ſufficient to dye freſh wool; for when ſhe has not a ſufficient heat, the colour ſhe gives would neither be uniform nor laſting, ſo that it muſt be re-heated, and freſh indigo put in as before. This may be

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done as often as judged proper, for this vat does not ſpoil by age, provided, that whilſt ſhe is kept without working, a little air is let into her.

Re-heating of the Vat with Urine.

About four in the afternoon, the whole liquor of the vat was put into a copper, and a ſufficient quantity of urine added to this liquor, to make up the deficiency that had been loſt by evaporation during the preceding work. This filling commonly takes eight or nine pails of urine; the liquor was then heated and ſcummed as before, and when ready to boil, returned into the vat with a pound of indigo, and the liquor above deſcribed, conſiſting of allum and tartar, of each one pound, madder one pound, and two quarts of urine. After raking the vat well, and covering her, ſhe was left at reſt the whole night.

The next day ſhe came to work, and ſixty pounds of wool were dyed in her at twice as before. It is after this manner all the re-heatings muſt be done the eve before the dying, and theſe re-heatings may extend to infinity, as the vat once ſet ſerves a long time.

I muſt here obſerve, that the greater the quantity of indigo put in at once is, the deeper the blue: thus, inſtead of one pound, four, five, or ſix pounds may be put in together; nor is it neceſſary to augment the doſe of allum, tartar, or madder, of which ingredients the liquor is compoſed: but if the veſſel hold more than three hogſheads, then the doſe of theſe muſt be augmented in proportion. The vat I have mentioned held three, and was too ſmall to dye at one time a ſufficient quantity of wool to make a piece of cloth, viz. fifty or ſixty pounds. For this purpoſe it would be neceſſary that the vat ſhould

should contain at least six hogsheads, and from this a double advantage would arise. 1. All the wool will be dyed in three or four hours, whereas dying it at twice, it takes eight or ten hours. 2. At the end of three hours, in which time the wool would be dyed, taken out, and the green taken off, the vat being yet very hot; after raking and letting her rest a couple of hours, the same wool might be returned into her, which would heighten the colour very much, for all wool that has been dyed, aired, and the green taken off, always takes a finer colour than new or white wool, which might remain twenty hours in the vat.

Great care must be taken to air and take off the green of the dyed parcels of wool that are taken out of the vat hastily, that the air may strike them equally, without which the blue colour will not be uniform throughout the wool.

There are manufacturers who say that cloths, whose wool has received this ground of blue with urine, cannot be perfectly scoured at the fulling mill, even at twice; others vouch the contrary, and I am of opinion the last speak the truth; yet, if the first are right, it might be suspected that the animal oil of the urine becoming rezinous by drying on the wool, or by uniting with the oil with which the oil is moistened; for its other preparations more strongly resist the fuller's earth and soap, than a simple oil by expression. To remedy this, the wool ought to be well washed in a running water after it is dyed, twisted, aired, the green taken off, and cooled. Be it as it may, the woad vat will always be preferred in the great dye-houses to those kinds of indigo vats made with urine or otherwise; and for this reason, that with a good woad vat, and an ingenious woadman, much more work is despatched than with all the other blue vats.

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I have deſcribed the indigo vats in this treatiſe, not with a deſign to introduce them in the large manufactories, but to procure eaſy means to the Dyers in ſmall, and ſmall manufactories, to whom I wiſh this work may be of as much advantage as to the others. I ſhall therefore here deſcribe a cold vat, which may be uſed with advantage by thoſe who dye ſmall ſtuffs, in whoſe compoſition thread and cotton enter. The colour is laſting, but cannot be made uſe of for wool.

CHAP. VI.

Of the COLD INDIGO VAT *without* URINE.

IT is cuſtomary at Rouen, and in ſome other cities of France, to dye in a cold indigo vat, different from that deſcribed in the foregoing chapter, and more covenient, as ſhe comes to work ſooner, and has no bad ſmell. She is prepared after the following manner:

Diſſolve three pounds of indigo powdered finely, in a glazed earthen pot, with three pints of ſtrong ſoap-boiler's lees, which is a ſtrong lee of ſoda and quick lime. The indigo takes about twenty-four hours diſſolving, and when perfectly ſo, remains ſuſpended in the liquor, thickens it, and gives it the conſiſtence of an extract. At the ſame time, three pounds of ſifted ſlacked lime muſt be put into another veſſel, with ſix quarts of water, and boiled together for a quarter of an hour; when ſettled, the clear is poured off by inclination. Then three pounds of green copperas are to be diſſolved in this clear lime-water, and the whole let to reſt till the next day. Three hundred quarts of water are then put in a large deal-veſſel (no other wood

wood but deal will do, for it would dull and blacken the dye, especially if it was oak.) The two solutions which were made the day before are put in, the vat is well raked, and suffered to rest. I have seen her come to colour in two hours after, but this never fails to happen the next day at farthest. She makes a great deal of flurry, and the liquor becomes of a fine green colour, but a little more on the yellow than the green of the common vat.

When this vat begins to spend herself, she is to be quickened without putting in fresh indigo, by making a small liquor with two pounds of green copperas, dissolved in a sufficient quantity of lime-water; but when the indigo has spent all its colour, she must be re-charged by putting in fresh, dissolved in such a lee as has been described.

Water of Old Iron.

Some Dyers put into this vat a little water of old iron. It is a mixture of vinegar and water, in which some old iron nails have been put to rust. They say this makes the colour more lasting, but I have experienced, that it is sufficiently so without this, and as good as all the other blues, of which I have before given the preparation.

I set several small vats; those that required to be heated were put in a bath or sand-heat, in small glass bodies; and those that are worked cold were left without doing any thing to them. These last are easy, being sufficient to diminish the quantity of liquor, and of all the other ingredients, in proportion to the vessel that is to be set, and it is almost impossible to fail.

As to that which I first described, which is set hot, as it is somewhat more difficult, and that several might be willing to try the experiment, which in

in itſelf is curious, and neither requires expence nor apparatus to perform in ſmall, I ſhall give the proceſs of one which ſucceeded perfectly, and in which I had deſignedly put a greater quantity of indigo than uſually is done in the common proportion.

I boiled two quarts of water with two ſcruples of madder and four ounces of pearl-aſhes; after boiling a quarter of an hour, I put it into a body, which held about four quarts, and had been previouſly heated with warm water, and in which I had put a quarter of a handful of bran. The whole was well ſtirred with a deal ſpatula, the glaſs body put on a very gentle ſand-heat, which only kept it warm, and pretty near the ſame degree of heat that is required for the common indigo vat.

The fire was kept all night, and the next day under the ſand-heat, without any ſenſible change happening; it was only ſtirred twice a-day. The next day ſome flurry began to riſe, and a copper-coloured ſkin formed on the ſurface, and the liquor was of a green-brown; it was then filled up with a liquor made of a quart of water, two ounces of pearl-aſhes, and a little bran. I mixed the whole together, then let it reſt. It came perfectly well to colour, and the next day I dyed ſeveral middling pieces of ſtuffs and wool. Theſe ſmall veſſels may be re-heated and charged again as eaſily as a large one.

I think I have nothing more to ſay concerning the method of ſetting to work all theſe kind of blue vats; yet I am perſuaded that there are ſeveral other means practiſed in different places, and that it is even eaſy to contrive new ones; however, I can affirm that all thoſe which I have deſcribed are very ſure, and that they have all been worked ſeveral times with the ſame ſucceſs.

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CHAP. VII.

Of the Method of DYING BLUE.

WHEN the vat is once prepared and come to work, the dying of wool or stuffs is easy. Wet them well in clear warm water, wringing and dipping them in the vat, and keeping them in more or less time, according as the colour is required in shade. From time to time the stuff is aired, that is, taken out of the vat and wrung, so that the liquor may fall back into the vat, and exposed a little to the air, which takes off the green in one or two minutes; for let what vat soever be used, the stuff is always green at its coming out, and only takes the blue colour in proportion as the air acts upon it. It is also very necessary to let the green go off before it is returned into the liquor to receive a second shade, as being then better able to judge of its colour, and know if it is requisite to give what is called one or several returnings.

It is an ancient custom among Dyers to reckon thirteen shades of blue from the deepest to the lightest. Although their denominations be somewhat arbitrary, and that it is impossible exactly to fix the just passage from one to the other, I shall notwithstanding give the names. They are as follow, beginning with the lightest: milk-blue, pearl-blue, pale-blue, flat-blue, middling-blue, sky-blue, queen's-blue, turkish-blue, watchet-blue, garter-blue, mazareen-blue, deep-blue, and very deep blue.

These distinctions are not equally received by all Dyers, nor in all provinces, but the most part are known; and it is the only method that can be taken to give an idea of the same colour, whose only difference is in being more or less deep.

It is eaſy to make deep blues. I have already ſaid, that to effect this, the wool or ſtuffs are to be returned ſeveral times into the vat; but it is not ſo in reſpect to light blues; for when the vat is rightly come to work, the wool can ſeldom be left in ſhort time enough, but that it takes more than the ſhade required. It often happens when a certain quantity of wool is to be dipped, and that it cannot all be put in at the ſame time, that what goes in at firſt is deeper than the other. There are ſome Dyers who, to obviate this inconveniency in making very light blues, which they call milk and water, take ſome of the liquor of the indigo vat, and dilute it in a very great quantity of lukewarm water; but this method is a bad one, for the wool dyed in this mixture has not near ſo laſting a colour as that dyed in the vat; as the altering ingredients which are put into the vat with the indigo, ſerves as much to diſpoſe the pores of the ſubject which is dipped in, as to the opening of the colouring fecula which is to dye it, their concourſe being neceſſary for the adheſion of the colour. The beſt method of making theſe very light blues, is to paſs them either in a woad or indigo vat, out of which the colour has been worked, and begins to cool. The woad vat is ſtill preferable to that of the indigo, as it does not dye ſo ſoon.

The blues made in vats that have been worked are duller than the others; but they may be pretty ſenſibly rouſed by paſſing the wool or ſtuffs in boiling water. This practice is even neceſſary to the perfection of all blue ſhades; by this the colour is not only made brighter, but alſo rendered more ſecure, by taking off all that is not well incorporated with the wool; it alſo prevents its ſpotting the hands or linen, which commonly happens, and

the Dyers, to gain time, neglect this precaution. After the wool is taken out of the warm water, it is necessary to wash it again in the river, or at least in a sufficient quantity of water for the carrying off all the superfluous loose dye.

The best method to render the blue dye brighter, is by filling them with a thin liquor of melted soap, and afterwards cleansing them from the soap by warm water, and, if convenient, by rinsing them in an old cochineal liquor. This method is to be taken with deep blues; but if the same was taken with very light blues, they would lose their bright-blue lustre and incline to grey.

I hope to have removed all difficulties on the preparation of blue, and in the method of dying it. Some Dyers, for the sake of gain, spare the woad and indigo, and use for blue, orchel or logwood, and brazil; this ought to be expressly forbid, though this adulterated blue is often brighter than a lasting and legitimate blue. I shall take notice of this in the chapters treating on the lesser dye.

I shall now explain the theory of the invisible change of the blue dye. This colour, which I shall here only consider in relation to its use in the dying of stuffs of what kind soever, has hitherto been extracted only from the vegetable world, and it does not appear that we can hope to use in this art the blues the painters employ: such are the Prussian blue, which holds of the animal and mineral kind *; the azure, which is a vitrified mineral substance; the ultramarine, which is prepared from a hard stone; the earths that have a blue colour, &c. These matters cannot, without losing their colour in whole or in part, be reduced

* 1749, Mons. Macquer, of the Royal Academy of Sciences, found the means of using the Prussian blue to dye silk and cloth, in a blue which in brightness surpassed all the blues hitherto known.

into

into atoms sufficiently minute, so as to be suspended in the saline liquid, which must penetrate the fibres of the animal and vegetable substances of which stuffs are manufactured; for under this name linen and cotton cloths must be comprehended, as well as those wove of silk and wool.

Hitherto we know but of two plants that yield blue after their preparation: the one is the isatis or glaustum, which is called pastel in Languedoc, and woad in Normandy. Their preparation consists in a fermentation continued even to the putrefaction of all the parts of the plant, the root excepted; and consequently in the unfolding of all their principles into a new combination, and fresh order of these same principles, from whence follows an union of infinite fine particles, which, applied to any subject whatever, reflects the light on them very different from what it would be, if these same particles were still joined to those which the fermentation has separated.

The other plant is the anil, which is cultivated in the East and West-Indies, out of which they prepare that fecula that is sent to Europe under the name of indigo. In the preparation of this plant the Indians and Americans, more industrious than ourselves, have found out the art of separating only the colouring parts of the plant from the useless ones; and the French and Spanish colonies have imitated them, and thereby made a considerable increase of commerce.

That the indigo, such as is imported from America, should deposit on the wool or stuffs the colouring parts required by the Dyer, it is infused several ways, the processes of which we have already given. They may be reduced to three; the cold indigo vat may serve for thread and cotton; those that are made use of hot, are fit for stuffs of any kind whatever.

In the cold vat, the indigo is mixed with pearl-ashes, copperas or green vitriol, lime, madder, and bran. The hot vats are either prepared with water or urine; if with water, pearl-ashes and a little madder must be added; if with urine, allum and tartar must be joined to the indigo. Both of these vats, principally intended for wool, require a moderate degree of heat, but at the same time strong enough for the wool to take a lasting dye, I mean such as will withstand the destroying action of the air and sun, the proof of dyes.

I have prepared, as I said before, these three vats in small, in cylindrical glass vessels, exposed to the light, in order to see what passed before the infusion came to a colour, that is, whether it was green beneath the flurry at the surface, which is a sign of internal fermentation. I have said that the green colour of the liquor is a condition absolutely essential, and without which, the colour the stuff would take would not be a good dye, and would almost entirely disappear on the least proofs.

I shall now give a description of the cold indigo vat in small, for the changes are much better seen in her, and for this reason, that what happens in the two others is not very essentially different. It is proper to take notice, that what I shall call *part*, in this Observation of Experiments, is a measure of the weight of four drachms, of all matter either liquid or solid, and that it will be this quantity that must be supposed, each time that I use that word in the detail of these experiments.

I put three hundred parts of water into a vessel, containing five hundred and twelve, or eight quarts, in which I dissolved six parts of copperas, which gave the liquor a yellow dye. Six parts of pot-ashes were also dissolved by themselves in thirty-six parts of water. The solution made, I digested in it

it ſix parts, or three ounces, of indigo of St. Domingo well ground; it was left over a very gentle fire three hours. The indigo ſwelled, and taking up a larger ſpace, roſe from the bottom of this alkaline liquor, with which it formed a kind of thick ſyrup, which was blue. This was a proof that the indigo was only divided, but not diſſolved; for had its ſolution been perfect, that thick liquor would have been green inſtead of blue; for all liquor that has been tinged blue by a vegetable of any kind, grows green on the admixion of an alkaline ſalt, either concrete or in a liquid form, whether it be a fixed or volatile.

From hence the reaſon is diſcovered why indigo does not dye a ſtuff of a laſting blue when its liquor is not green; for its ſolution not being compleat, the alkali cannot act upon theſe firſt elementary particles; as for example, it acts on the tincture of violets, which is a perfect ſolution of the colouring parts of thoſe flowers, which it turns green in an inſtant, and on the firſt contact.

I poured this thick blue liquor into the ſolution of vitriol, and after well ſhaking the mixture, I added ſix parts of lime that had been ſlacked in the air; it was cold weather when this experiment was made; the thermometer was at two degrees under the freezing point, which was the cauſe that this was near four days coming to a colour, and the fermentation, which muſt naturally enſue in all vitriolic liquor, where an alkaline ſalt has been put in, ſuch as pot-aſhes, and an alkaline earth, was carried on with ſo much ſlowneſs that very little ſcum appeared on the ſurface of the liquor. In a hot ſeaſon, and by making uſe of lime newly calcined, theſe kind of vats are ſometimes fit to dye in four hours.

Each

Each time I stirred the mixture with a spatula, I observed that the iron of the vitriol or copperas was the first that precipitated to the bottom of the vessel, and that the alkaline salt had precipitated it, to join itself to the acid. Thus in this process of the cold indigo vat, a tartar of vitriol after the manner of Tachenius is formed; whereas by the common method of preparing this neutral salt, the acid of vitriol is poured on a true alkaline salt, such as salt of tartar or pot-ashes. This again is a circumstance that leads insensibly to the theory of the good dye. I desire the reader to take notice of this, as it will occur in the sequel of this observation, as well as in other chapters.

The earthy parts of the lime precipitate next after the iron; they are easily distinguished by the whiteness, which are yet difficult to distinguish when the colouring parts of the indigo are sufficiently loosened. In short, under this white earth the fecula of the indigo deposits itself, and by degrees rarifies in such a manner, that this substance, which the first day was only the eighth of an inch above the precipitated lime, rose insensibly within half an inch of the surface of the liquor, and the third day grew so opaque and muddy that nothing further could be distinguished.

This rarefaction of the indigo, slow in winter, quick in summer, and which may be accelerated in winter by heating the liquor to fifteen or sixteen degrees, is a proof that a real fermentation happens in the mixture, which opens the little lumps of indigo, and divides them into particles of an extreme fineness; then their surfaces being multiplied almost *ad infinitum*, they are so much the more equally distributed in the liquor, which deposits them equally on the subject dipped in to take the dye.

If

If fermentation comes on haſtily, or in a few hours, whether on account of the heat of the air, or by the help of a ſmall fire, a great quantity of ſlurry appears; it is blue, and its reflection they have alſo named coppery, becauſe the colours of the rainbow appear in it, and the red and yellow here predominate; however this phænomenon is not peculiar to indigo, ſince the ſame reflection is perceived in all mixtures that are in actual fermentation, and particularly in thoſe which contain fat particles blended with ſalts, urine, ſoot, and ſeveral other bodies put into fermentation, ſhew on their ſurface the ſame variegated colours.

The ſlurry of the indigo vat appears blue, becauſe expoſed to the external air; but if a ſmall portion of the liquor which is under it be taken up with a ſpoon, it appears more or leſs green in proportion as it is filled with colouring particles. In the courſe of this obſervation, I ſhall ſhew the reaſon of this difference, or, at leaſt, a probable explication of this change of blue, which, as I have ſaid before, is abſolutely neceſſary for ſucceeding in the proceſs deſcribed.

When the vat is in this ſtate, it has already been ſaid that cotton, thread, cloths wove from them, &c. may be dyed in her, and the colours which they take are of the good dye; that is, this cotton and thread will maintain them, even after remaining a ſuitable time in a ſolution of white ſoap, actually boiling. This is the proof given them preferable to any other, becauſe the linen and cotton cloths muſt be waſhed with ſoap when dirty.

Though the indigo liquor which is in this ſtate can make a laſting dye without the addition of any other ingredient; the Dyers who uſe this cold vat add, as in the other hot vats, a decoction of madder and bran in common water run through a ſieve; this

this is what they call *bever*. They put madder to insure, as they say, the colour of the indigo, because this root affords a colour so adhesive that it stands all proofs; they put the bran to soften the water, which they imagine generally to contain some portion of an acid salt, which, according to their opinion, must be deadened.

This was the opinion of the French Dyers against indigo in the days of Monsier Colbert; and as this Minister could not spare time to see the experiments performed in his presence, on the foundation of this report, he forbad indigo to be used alone. But since the Government has been convinced, by new experiments made by the late Mr. Dufay, that the stability of the blue dye of this ingredient was such as could be desired; the new regulation of 1737, licenses the Dyers to use it alone or mixed with woad; so that if they continue to use the madder, it is rather because this root giving a pretty deep red, and this red mixing with the blue of the indigo, gives it a tint which approaches the violet, and also a fine hue.

As to the bran, its use is not to deaden the pretended acid salts, but to disperse throghout a quantity of sizey matter; for the small portion of flour which remains in it, dividing itself into the liquor, must diminish in some measure its fluidity, and consequently prevent the colouring particles which are suspended in it, being precipitated too quick, in a liquor which had not acquired a certain degree of thickness.

Notwithstanding this distributed throughout the liquor, as well from the bran as the madder, which also affords something glutinous, the colouring particles will subside if the liquor remains some days without being stirred; then the top of the liquor gives but a feeble tint to the body dipped in, and if a strong

a ſtrong one is wanted, the mixture muſt be raked, and left to reſt an hour or two, that the iron in the copperas, and the groſs parts of the lime may fall to the bottom, which otherwiſe would mix with the true colouring particles, and prejudice their dye, by depoſiting on the body to be dyed a ſubſtance that would have but little adheſion, which in drying would become friable, and of which each minute part would occupy a ſpace, where the true colouring particle could neither introduce nor depoſit itſelf by an immediate contact on the ſubject.

Not to deviate from the method followed by the Dyers, I boiled one part of grape-madder and one of bran, in 174 parts of water: this proportion of water is not neceſſary, more or leſs may be put, but I wanted to fill my veſſel, which contained 512 parts. I paſſed this bever through a cloth and ſqueezed it, putting this liquor, ſtill hot, and which was of a blood-red, into the indigo liquor, obſerving the neceſſary precautions to prevent the breaking of the glaſs veſſel. The whole was well ſtirred, and two hours after the liquor was green, and conſequently fit for dying. It dyed cotton of a laſting blue, ſomewhat brighter than it was before the addition of the red of madder.

I ſhall now endeavour to find out the particular cauſe of the ſolidity of this colour; perhaps it may be the general cauſe of the tenacity of all the reſt; for it appears already, from the experiments above related, that this tenacity depends on the choice of ſalts, which are added to the decoctions of the colouring ingredients, when theſe ſame ingredients contain none in themſelves. If from the conſequences which ſhall reſult from the choice of theſe ſalts, of their nature, and of their properties, it be admitted (and it cannot be fairly denied) that they afford more or leſs tenuity in the homogeneous

colouring

colouring parts of the dying ingredients, the whole theory of this art will be discovered, without having recourse to uncertain or contested causes.

One may easily conceive that the salts added to the indigo vats not only open the natural pores of the subject to be dyed, but also unfold the colouring atoms of the indigo.

In the other preparations of dyes (to be mentioned hereafter) the woollen stuffs are boiled in a solution of salts, which the Dyers call preparation. In this preparation tartar and allum are generally used. In some hours the stuff is taken out, slightly squeezed, and kept damp for some days in a cool place, that the saline liquor which remains in it may still act, and prepare it for the reception of the dye of these ingredients, in the decoction of which it is plunged to boil again. Without this preparation, experience shews that the colours will not be lasting, at least for the greatest part; for it must be owned that there are some ingredients which yield lasting colours, though the stuff has not previously undergone this preparation, because the ingredient contains in itself these salts.

It is therefore necessary, that the natural pores of the fibres of the wool should be enlarged and cleansed by the help of those salts, which are always somewhat corroding, and perhaps they open new pores for the reception of the colouring atoms contained in the ingredients. The boiling of this liquor drives in the atoms by repeated strokes. The pores already enlarged by these salts, are further dilated by the heat of the boiling water; they are afterwards contracted by the external cold when the dyed matter is taken out of the copper, when it is exposed to the external air, or when it is plunged into cold water. Thus the colouring atom is taken in, and detained in the pores or fissures of the

the dyed body, by the ſpringineſs of its fibres, which have contracted and reſtored themſelves to their firſt ſtate, and have reaſſumed their primary ſtiffneſs upon being expoſed to the cold.

If, beſides this ſpring of the ſides of the pore, it be ſuppoſed that theſe ſides have been plaiſtered inwardly with a layer of the ſaline liquor, it will appear plainly that this is another means employed by art to detain the colouring atom; for this atom, having entered into the pore, while the ſaline cement of the ſides was yet in a ſtate of ſolution, and conſequently fluid; and this cement being afterwards congealed by the external cold, the atom is thereby detained; by the ſpring which has been mentioned, and by this ſaline cement, which by chryſtalization is become hard, forms a kind of maſtic which is not eaſily removed.

If the coloured atom (which is as ſmall as the little eminence that appears at the entrance of the pore, and without which the ſubject would not appear dyed) be ſufficiently protuberant to be expoſed to more powerful ſhocks than the reſiſtance of the ſides of the cement that retains it, then the dye reſulting from all theſe atoms ſufficiently retained, will be extremely laſting, and in the rank of the good dye, provided the ſaline coat can neither be carried off by cold water, ſuch as rain, nor calcined or reduced to powder by the rays of the ſun; for every laſting colour, or colour belonging to the good dye, muſt withſtand theſe two proofs. No other can reaſonably be expected in ſtuffs deſigned for apparel or furniture.

I know but of two ſalts in chymiſtry, which, being once chryſtalized, can be moiſtened with cold water without diſſolving; and there are few beſides theſe that can remain ſeveral days expoſed to the ſun, without being reduced to a flour or

 white

white powder. These are tartar, either as taken from the wine vessels, or purified, and tartar of vitriol. The tartar of vitriol may be made by mixing a salt already alkalized, (or that may become such when the acid is drove out with a salt whose acid is vitriolic as copperas and allum); this is easily effected if it be weaker than the acid of vitriol, and such is the acid of all essential salts extracted from vegetables.

In the process of the blue vat, which I tried in small, to discover the cause of its effects, copperas and pot-ash (which is a prepared alkali) are mixed together; as soon as these solutions are united, the alkali precipitates the iron of the copperas in form of powder almost black; the vitriolic acid of the copperas, divested of its metallic basis by its union with the alkali, forms a neutral salt, called *tartar of vitriol*, as when made with the salt of tartar and the vitriolic acid already separated from its basis; for all alkalis, from whatever vegetables they are extracted, are perfectly alike, provided they have been equally calcined.

More difficulties will occur with regard to the water for the preparation of other colours, such as reds and yellows. It may be denied that a tartar of vitriol can result from the mixture of allum and crude tartar boiled together; yet the theory is the same, and I do not know that it can be otherwise conceived. The allum is a salt, consisting of the vitriolic acid united with an earth; by adding an alkali, the earth is immediately precipitated, and the tartar soon forms; but instead of this alkaline salt, allum is boiled with the crude tartar, which is the essential salt of wine, that is, a salt composed of the vinous acid (which is more volatile than the vitriolic) and of oil, both concentrated in a small portion of earth.

This

This salt, as is known to chymists, becomes alkali by divesting it of its acid. Thus when the allum and crude tartar are boiled together, besides the impression which the fibres of the stuff to be dyed receive from the first of these salts, which is somewhat corrosive, the tartar is also purified, and by the addition of the earth, which is separated from the allum, (and which has near the same effect upon the tartar, as the earth of *Merviels*, which is used at Montpellier in manufacturing cream of tartar) it becomes clear and transparent. It may very probably happen, that the vitriolic acid of the allum, driving out a part of the vegetable acid of the tartar, a tartar of vitriol may be formed as hard and transparent as the chrystal of tartar. Admitting one or other of these suppositions, consequently there is in the open pores of the wool a saline cement which chrystalizes as soon as the stuff which comes out of the dye is exposed to the cold air, which cannot be calcined by heat, nor is soluble in cold water. I could not avoid making this digression.

This theory is common to the indigo vat, where urine is used instead of water; allum and crude tartar in the place of vitriol and pot-ashes. This urine vat gives a lasting dye only when used hot, and then the wool must remain in an hour or two to take the dye equally. As soon as the vat is cold, she strikes no more dye; the reason of this would be difficult to discover in an opaque metal vat, but in a glass vessel it is easily seen.

I let this little glass proof vat cool, and all the green colour, which was suspended in it while hot, precipitated little by little to the bottom; for then the tartar chrystalizing itself, and reuniting in heavier masses than its moculas were during the heat of the liquor, and its solution, it sunk to the

bottom of the veſſel, and carried with it the colouring particles.

When I reſtored this liquor to its former degree of heat, after ſhaking it, and letting it ſettle awhile, I dipped a piece of cloth, which I took out one hour after, with as laſting a dye as the firſt; ſo that when this vat is uſed and fit to work, the tartar is to be kept in a ſtate of ſolution, which cannot be done but by a pretty ſtrong heat. The alkali of the urine greens it, the allum prepares the fibres of the wool, and the chryſtal of tartar ſecures the dye by cementing the colouring atoms depoſited in the pores.

There ſtill remains a difficulty with reſpect to the indigo vat, in which, neither vitriol, allum, or tartar are uſed, but only pearl-aſhes in equal quantity with the indigo, and which is pretty briſkly heated to dye the wool and ſtuffs. But before I enter into the cauſe of the ſolidity of its dye, which is equal to that of the other blue vats where the other ſalts already mentioned enter, I muſt examine into the nature of pearl-aſhes, which are the lees of wine dried and calcined: it is therefore an alkaline ſalt, of the nature of ſalt of tartar but leſs pure, as proceeding from the heavieſt parts of the dregs of wine, and conſequently the moſt earthy; beſides, the alkali of the pearl-aſhes is never as homogeneous as the alkaline ſalt of tartar well calcined, and there are ſcarcely any pearl-aſhes not purified, from which a conſiderable quantity of tartar of vitriol may not be obtained: it is even probable by an experiment which I have related, that it might at length be entirely converted into this neutral ſalt; the ſame may be ſaid of pot-aſhes, and of all other alkaline ſalts, whoſe baſis are not that of the marine ſalt.

The

The want of this homogenous quality, is the cause that pearl-ashes never fall entirely into deliquium in the air; therefore since experience shews that there is a tartar of vitriol already formed in the pearl-ashes, it is evident that this indigo vat, which does not give a good dye until the liquor has been so briskly heated as not to suffer the hand without scalding, will dissolve the small portion of tartar of vitriol that is contained in it, and consequently this salt will introduce itself into the pores of the wool to cleanse and cement them, and will coagulate therein on the wool being taken out of the liquor, and exposed to the air to cool.

I must now give the reason why the indigo vat is green under the first surface of the liquor; why this liquor must be green that the blue dye may be lasting, and why the stuff that is taken green out of the liquor becomes blue as soon as it is aired. All these conditions being of necessity common to all indigo vats either cold or hot, the same explication will serve for them all.

1. The flurry which rises on the surface of the indigo liquor when it is fit to dye, is blue, and the under part of this scum is green; these two circumstances prove the perfect solution of the indigo, and that the alkaline salt is united to its colouring atoms since it greens them, for without they would remain blue.

2. These circumstances prove that there is also in the indigo a volatile urinous alkali, which the fixt alkali of the pot-ash, or the alkaline earth of the lime displays, and which evaporates very shortly after the exposition of this scum to the air. The existence of this urinous volatile appears plainly by the smell of the vat during the fermentation; when stirred, or when heated, the smell is sharp, and resembles that of stinking meat roasted.

 3. In

3. In the preparation of the anil, in order to ſeparate the fecula, a fermentation is continued to putrefaction. All rotten plants are urinous. This volatile urinous quality is produced by the intimate union of ſalts with the vegetable oil, or is owing to a prodigious quantity of inſects falling on all ſides of fermenting planks, and attracted by the ſmell exhaling from them, where they live, multiply, and die in them, and conſequently depoſit a number of dead bodies; therefore to this vegetable ſubſtance an animal one is united, whoſe ſalt is always an urinous volatile. This ſame urinous quality exiſts alſo in the woad, which is prepared after the ſame manner, viz. by fermentation and putrefaction, and which will be further explained in the abridged narrative of its preparation.

4. And laſtly, if indigo or woad be diſtilled in a retort, either alone or (which is much better) with ſome fixed ſaline or earthly alkali added to it, a liquor will be obtained, which, by all chymical eſſays, produces the ſame effects as volatile ſpirits of urine.

Why does not this volatile urinous quality in the indigo cauſe it to appear green, ſince it muſt be equally diſtributed through all its parts? And why does indigo, being diſſolved in plain boiling water, tinge it blue and not green? It is becauſe this volatile urinous ſalt is not concreted; that it requires another body more active than boiling water to drive it out of the particles ſurrounding it; and the ſolution of indigo is never perfected by water alone; whatever degree of heat is given, it is only diluted, and not diſſolved in it. Indeed this decoction of indigo blues the ſtuffs that are dipped, but the blue is not equally laid on, and boiling water almoſt inſtantly diſcharges it. I ſhall endeavour to anſwer this by an example drawn from another ſubject.

Salt

Salt ammoniac, from which chymiſts extract the moſt penetrating volatile ſpirit, has not that quick urinous ſmell by diſſolving and boiling it in water; either lime, or a fixed alkaline ſalt, muſt be added to diſengage the urinous volatile parts. In like manner, the indigo requires fixed ſaline, or earthly alkalis, to be exactly diſcompoſed, that its volatile urinous ſalt may be diſcovered, and that its colouring atoms may be reduced probably to their elementary minuteneſs.

I now come to the ſecond quality required. The liquor of the indigo vat muſt be green, that the dye may be laſting; for the indigo would not be exactly diſſolved, if the alkali did not act upon it. Its ſolution not being as perfect as it ought to be, its dye would be neither equal nor laſting; but as ſoon as the alkaline ſalts act upon it, they muſt green it; for an alkali, mixed with the blue juice or tincture of any plant or flower, immediately turns it green, when equally diſtributed on all its colouring parts. But if by evaporation theſe ſame parts, coloured, or colouring, have re-united themſelves into hard and compact maſſes, the alkali will not change their colour till it has penetrated, divided, and reduced them to their primary fineneſs. This is the caſe with indigo, whoſe fecula is the dry inſpiſſated juice of the anil.

With reſpect to the laſt circumſtance, which is that the ſtuff muſt be green on coming out of the liquor, and become blue as ſoon as it is aired, without which, the blue would not be of a good dye, the following reaſons may be given: it is taken out green becauſe the liquor is green; if it was not, the alkaline ſalt put into the vat would not be equally diſtributed, or the indigo would not be exactly diſſolved. If the alkali was not equally diſtributed, the liquor contained in the vat would not be

be equally ſaline: the bottom of this liquor would contain all the ſalt; the upper would be inſipid. In this caſe, the ſtuff dipped in would neither be prepared to receive the dye, nor to retain it; but when it is taken out green at the end of a quarter of an hour's dipping, it is a proof that the liquor was equally ſaline, and equally loaded with colouring atoms; it is alſo a ſign, that the alkaline ſalts have inſinuated themſelves into the pores of the fibres of the ſtuff and enlarged them, as has been obſerved, and perhaps have formed new ones. Now there can be no doubt that an alkaline ſalt may have this effect on a woollen ſtuff, when it is evident that a very ſharp alkaline ley burns and diſſolves almoſt in an inſtant a flock of wool or a feather.

A proceſs in dying called, by the French, *fonte de bourre*, that is, the melting or diſſolving of flock or hair, is ſtill a further example. The hair, which is uſed and boiled in a ſolution of pearl-aſhes in urine, is ſo perfectly diſſolved as not to leave the leaſt fibre remaining. Therefore if a lixivium, extremely ſharp, entirely deſtroys the wool, a ley which ſhall have but a quantity of alkaline ſalt ſufficient to act on the wool without deſtroying it, will prepare the pores to receive and preſerve the colouring atoms of the indigo.

The ſtuff is aired after being taken green out of the vat, and after wringing it becomes blue. What is done by airing? it is cooled; if it is the urinous volatile detached from the indigo which gave it this green colour, it evaporates, and the blue appears again; if it is the fixed alkaline that cauſes this green, not only the greateſt part is carried off by the ſtrong expreſſion of the ſtuff, but what remains can have no more action on the colouring part, becauſe the ſmall atom of tartar of vitriol,

which

which contains a coloured atom ſtill leſs than itſelf, is chryſtalized the inſtant of its expoſition to the cold air, and contracting this ſame colouring atom by the help of the ſpring at the ſides of the pore, it entirely preſſes out the remainder of the alkali, which does not chryſtalize as a neutral ſalt.

The blue is rouſed, that is, it becomes brighter and finer by ſoaking the dyed ſtuff in warm water, for then the colouring particles, which had only a ſuperficial adherence to the fibres of the wool, are carried off. Soap is uſed as a proof of the laſting of the blue dye, and it muſt ſtand it, for the ſoap, which is only uſed in a ſmall quantity in proportion to the water, and whoſe action on the dyed pattern is fixed to five minutes, is an alkali, mitigated by the oil, which cannot act upon a neutral ſalt. If it diſcharges the pattern of any part of its colour, it is becauſe its parts were but ſuperficially adhering; beſides, the little ſaline chryſtal which is ſet in the pore, whoſe uſe is to cement the colouring atom, cannot be diſſolved in ſo ſhort a time, ſo as to come out of the pore with the atom it retains.

This treatiſe lays down the eſſay of a method of dying different from any hithorto offered. I appeal to philoſophers, who would think little of a ſimple narrative of proceſſes, if I did not at the ſame time give their theory. I ſhall follow this method in the other experiments on reds, the yellows, or other ſimple colours, as it is abſolutely neceſſary to have a knowledge of them before entering on the compound, as theſe are generally but colours laid on one after the other, and ſeldom mixed together in the ſame liquor or decoction.

Thus having once the knowledge of what procures the tenacity of a ſimple colour, it will be more eaſily known, if the ſecond colour can take place in the ſpaces the firſt have left empty without diſplacing the firſt.

This

This is the idea which I have formed to myself of the arrangement of different colours laid on the same stuff, for it appears to me a matter of great difficulty to conceive that the colouring atoms can place themselves the one on the other, and thus form kinds of pyramids, each still preserving their colour, so that from a mixture of the whole a compound colour shall result, and which, notwithstanding, shall appear uniform, and as it were homogeneous. To adopt this system, we must suppose a transparency in these atoms, which it would be difficult to demonstrate; and further, that a yellow atom must place itself immediate on a blue one, already set in the pore of the fibre of a stuff, and that it must remain there strongly bound, so that they must touch each other with extreme smooth surfaces, and so with every new colour laid on.

It is not easy to conceive all this, and it appears more probable, that the first colour has only taken up the pores that it found open by the first preparation of the fibres of the stuff; that on the side of these pores there remains more still to be filled, or at least spaces not occupied, where new pores may be opened to lodge the new atoms of a second colour, by the means of a second preparation of water, composed of corroding salts, which being the same as those of the first preparing liquor, will not destroy the first saline chrystals, introduced into he first pores.

What has been already said with regard to the indigo vat, may also serve to explain the action of the woad vat on wool and stuffs; it is only supposing in the woad, that salts do naturally exist, pretty near of affinity to those that are added to the indigo vat. It appears by the description given of these vats, that the woad vat is by much the most

difficult

difficult to conduct. I am convinced that these difficulties might be removed, if an attempt was made to prepare the isatis as the anil is in the West-Indies. I shall therefore compare their different preparations. I have taken the following narrative from the memoirs of Mr. Astruc's *Histoire Naturelle du Languedoc. Paris, Cavelier* 1737, in 4to, p. 330 and 331.

" According to the opinion of Dyers, woad " only gives feeble and languishing colours; " whereas those of the indigo are lively and bright. " This opinion I grant is conformable to reason: " the indigo is a fine subtle powder; consequent- " ly capable to penetrate the stuffs easily, and " give them a shining colour. The woad, on the " contrary, is only a gross plant, loaded with " many earthy parts, which slacken the action and " motion of the finer parts, and prevent them " from acting effectually.

" I know but one way to remove this incon- " veniency, that is, to prepare the woad after the " same manner the indigo is prepared; by this " means, the colours obtained from the woad " would acquire the lively and bright qualities of " those procured from the indigo, without dimi- " nishing in the least the excellency of the colours " produced by the woad.

" I have already made in small * experiments on " what I propose, and those experiments have suc- " ceeded, not only in the preparation of the powder " of woad, but also in the use of this powder for " dying."

It

* As this ingenious man has succeeded in small experiments, it is probable he would also in the large ones; and then this plant, easily cultivated in England, would well recompence the pains of the husbandman.

It is incumbent on thoſe who have the public good at heart, to cauſe trials at large to be made, and if they have the ſucceſs that can reaſonably be expected, it will be proper to encourage thoſe who cultivate woad, to follow this new method of preparing it, and offer premiums to enable them to ſuſtain the expences this new practice will engage them in, until the advantage they will reap from it may be ſufficient to determine them to follow it.

I ſhall now propoſe the means to ſucceed in Mr. Aſtruc's experiments, and theſe means naturally reſult from conſidering the method uſed in Languedoc for the preparation of woad, and the ingenious method by which they ſeparate the fecula of the anil in America. I have already given the preparation of this laſt; thoſe who deſire a fuller deſcription may conſult *l'Hiſtoire des Antilles du P. du Tertre & du P. Labat.* The following preparation of the paſtel, or garden woad, is thus deſcribed by Mr. Aſtruc.

The manufacturing of Paſtel, or Garden Woad in France.

Peaſants of Abbigevois diſtinguiſh two kinds of woad ſeed; the one violet colour, the other yellow: they prefer the former, becauſe the woad that ſhoots from it bears leaves that are ſmooth and poliſhed, whereas thoſe that ſpring from the yellow are hairy; this fills them with earth and duſt, which makes the woad prepared from them of a worſe quality. This woad is called *paſtelbourg*, or *lourdaigne.*

The woad at firſt ſhoots five or ſix leaves out of the ground, which ſtand upright whilſt green; they are a foot long, and ſix inches broad; they begin to ripen in June; they are known to be ripe by their

their falling down and growing yellow; they are then gathered, and the ground cleared from weeds, which is carefully repeated each crop.

If there has been rain, a ſecond crop is obtained in July; rain or dry weather advances or retards it eight days. The third crop is at the latter end of Auguſt; a fourth the latter end of September; and the fifth and laſt about the tenth of November. This laſt crop is the moſt conſiderable, the interval being longer. The plant at this crop is cut at the root from whence the leaves ſpring. This woad is not good, and the laſt crop is forbid by the regulations. The woad is not to be gathered in foggy or rainy weather, but in ſerene weather, when the ſun has been out ſome time.

At each crop the leaves are brought to the mill to be ground, and reduced to a fine paſte; this is to be done ſpeedily, for the leaves when left in a heap ferment, and ſoon rot with an intolerable ſtench. Theſe mills are like the oil or bark-mills, that is, a millſtone turns round a perpendicular pivot, in a circular grove or trough, pretty deep, in which the woad is ground.

The leaves thus maſhed and reduced to a paſte, are kept up in the galleries of the mill, or in the open air. After preſſing the paſte well with the hands and feet, it is beat down and made ſmooth with a ſhovel. This is called the woad piled.

An outward cruſt forms, which becomes blackiſh; when it cracks, great care muſt be taken to cloſe it again. Little worms will generate in theſe crevices and ſpoil it. The pile is opened in a fortnight, well worked between the hands, and the cruſt well mixed with the inſide; ſometimes this cruſt requires to be beat with a mallet to knead it with the reſt.

This paſte is then made into ſmall loaves or round balls, which, according to the regulations,

F muſt

muft weigh a pound and a quarter. Thefe balls are well preffed in the making, and are then given to another, who kneads them again in a wooden difh, lengthens them at both ends, making them oval and fmooth. Laftly, they are given to a third, who finifhes them in a leffer bowl-difh, by preffing and perfectly uniting them.

The paftel or woad thus prepared is called *Paftel en Cocaigne*; whence arifes the proverb, *Pais de Cocaigne*; which fignifies a rich country, becaufe this country * where the woad grows, enriched itfelf formerly by the commerce of this drug.

Thefe balls † are fpread on hurdles, and expofed to the fun in fine weather; in bad weather they are put at the top of the mill. The woad that has been expofed fome hours to the fun, becomes black on the outfide, whereas that which has been kept within doors is generally yellowifh, particularly if the weather has been rainy. The merchants prefer the former; this makes little difference as to its ufe; it is in general always yellowifh, as the peafants moftly work it in rainy weather, when they cannot attend their rural employments.

In fummer, thefe balls are commonly dry in fifteen or twenty days, whereas in autumn thofe of the laft crop are long in drying.

The good balls when broke are of a violet colour within, and have an agreeable fmell; whereas thofe that are of an earthy colour and a bad fmell, are not good: this proceeds from the gathering of the woad during the rain, when the leaves were filled with earth. Their goodnefs is alfo

* *L'Abigeois & Lauragois.*

† There is a place in India, the name I do not recollect, where the anil is prepared after the manner of the woad, and the indigo comes from it in lumps, containing all the [illegible] parts of the plant.—It is very difficult to prepare a blue vat with it.

alſo known by their weight, being light when they have taken too much air, or rotten by not having been ſufficiently preſt.

Powder of Woad.

Of theſe balls well prepared, the powder of woad is to be made; for this purpoſe a hundred thouſand at leaſt are required. A diſtant barn or a warehouſe muſt be procured, larger or ſmaller according to the quantity intended to be made. It muſt be paved with bricks and lined with the ſame, to the height of four or five feet, the walls would be better to be of ſtone to that height, yet often the walls are only coated with earth; this coat breaking off and mixing with the woad is a great prejudice to it. In this place the balls are reduced to a groſs powder with large wooden mallets. This powder is heaped up to the height of four feet, reſerving a ſpace to go round, and is moiſtened with water; that which is ſlimy * is beſt, provided it be clear; the woad thus moiſtened, ferments, heats, and emits a very thick ſtinking vapour.

It is ſtirred every day for twelve days, flinging it by ſhovels full from one ſide to the other, and moiſtening it every day during that time; after which no more water is flung on, but only ſtirred every ſecond day; then every third, fourth, and fifth; it is then heaped up in the middle of the place, and looked at from time to time to air it in

* I can ſee no reaſon why ſlimy water, and yet to be clear, is preferred. It appears to me that clear river water would be more ſecure: with this they would avoid the inconveniencies that muſt attend a ſtanding water, always filled with filth; or of a muddy water, which contains much earth, and which muſt make the dye uneven.

ſe it ſhould heat. This is the paſtel or garden woad powder fit for ſale to the Dyers.

Mr. Aſtruc, to prove that the ſale of woad formerly enriched the higher Lauguedoc, quotes the following paſſage from a book entitled *Le Marchand.*

"Formerly they tranſported from Toulouze to Bourdeaux, by the river Garonne, each year a hundred thouſand bales of woad, which on the ſpot are worth at leaſt fifteen livres a bale, which amounts to 1,500,000 livres; from whence proceeded the abundance of money and riches of that country." Caſtel in his *Memoirs de l'Hiſtoire du Languedoc*, in 1633, p. 49.

The comparing of theſe two methods of preparing the woad and indigo may be ſufficient to a perſon of underſtanding, who might be appointed to try, by experiments, the poſſibility of extracting a fecula from the iſatis of Languedoc like that of the anil. It is neither the Dyer or Manufacturer that ought be applied to for that purpoſe; both would condemn the project as a novelty, and it would require many experiments, which in general they are not accuſtomed to.

I could wiſh this experiment was tried in great, ſo that at leaſt fifty pounds of this fecula might be got, that ſeveral vats might be ſet in caſe the firſt ſhould fail. Whoever does try it, ſhould be very careful to deſcribe all the circumſtances of the proceſs. Perhaps it might not ſucceed at the firſt crop of the leaves of the woad, becauſe the heat in June is not ſufficient, but probably he might meet with ſucceſs in Auguſt.

If this ſucceeds, there are without doubt ſeveral other plants of the ſame quality as the iſatis, and which yield a like fecula.

It is alſo probable that the dark green of ſeveral plants is compoſed of yellow and blue parts; if by fermentation

fermentation the yellow could be deſtroyed, the blue would remain. This is not a chymerical idea, and it is eaſy to prove that ſome uſe might be derived from ſuch an experiment.

CHAP. VIII.

Of RED.

RED, as has been ſaid, is one of the primary or mother colours of the Dyers. In the great dye there are four principal reds, which are the baſis of the reſt. Theſe are,

1. Scarlet of grain. 2. The ſcarlet, now in uſe, or flame-coloured ſcarlet, formerly called Dutch ſcarlet. 3. The crimſon red. And, 4. The madder red.

There are alſo the baſtard ſcarlet and the baſtard crimſon; but as theſe are only mixtures of the principal reds, they ought not to be conſidered as particular colours.

The red, or *nacarat* of *bourre* *, was formerly permitted in the great dye.

All theſe different reds have their particular ſhades from the deepeſt to the lighteſt, but they form ſeparate claſſes, as the ſhades of the one never fall into thoſe of the other.

The reds are worked in a different manner from the blues, the wool or ſtuffs not being immediately dipped in the dye, but previouſly receiving a preparation which gives them no colour, but prepares them to receive that of the colouring ingredient.

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* This colour is given with weld and goat's hair boiled in pot-aſhes, and is a bright orange red.

This is called the water of preparation it is commonly made with acids, ſuch as ſour waters, allum and tartar, aqua fortis, aqua regalis, &c. Theſe preparing ingredients are uſed in different quantities, according to the colour and ſhade required. Galls are alſo often uſed, and ſometimes alkaline ſalts. This I ſhall explain in the courſe of this treatiſe, when I come to the method of working each of theſe colours.

C H A P IX.

Of SCARLET of GRAIN.

THIS colour is called ſcarlet of grain, becauſe it is made with the kermes, which was long thought to be grain of the tree on which it is found. It was formerly called French ſcarlet, imagining it to be firſt found out in France, and is now known by the name of Venetian ſcarlet, being much in uſe there, and more made than in any other place. The faſhion paſſed from thence into France and other countries. It has indeed leſs luſtre, and is browner than the ſcarlet now in faſhion; but it has the advantage of keeping its brightneſs longer, and does not ſpot by mud or acid liquors.

The kermes is a gall inſect, which is bred, lives, and multiplies upon the *ilex acculeato cocci glandiſera*, *C. B. P.* Some comes from Narbonne, but greater quantities from Alicant and Valentia, and the peaſants of Languedoc yearly bring it to Montpelier and Narbonne. The merchants, who buy them to ſend abroad, ſpread them on cloths, and ſprinkle them with vinegar, in order to kill the little inſects that are within, which yield a red powder,

powder, which is ſeparated from the ſhell after drying, and is then paſſed through a ſieve; this is done particularly in Spain.

They then make it up in bales, and in the middle of each a quantity of this powder is incloſed in a leather bag, in proportion to the whole bale. Thus each Dyer has his due proportion of this powder. Theſe bales are generally ſent to Marſeilles, from whence they are exported to the Levant, Algiers, and Tunis, where it is greatly made uſe of in dying.

The red draperies of the figures in the ancient tapeſtry of Bruſſels, and other manufactories of Flanders, are dyed with this ingredient; and ſome that have been wrought upwards of two hundred years, have ſcarcely loſt any thing of the brightneſs of the colour. I ſhall now proceed to give the method of making this ſcarlet of grain, which is now ſeldom uſed but for wools deſigned for tapeſtry.

Preparation of the Wool for Scarlet of Grain.

Twenty pounds of wool and half a buſhel of bran are put into a copper, with a ſufficient quantity of water, and ſuffered to boil half an hour, ſtirring it every now and then; it is then taken out to drain.

It is neceſſary to obſerve, that whenever ſpun wool is to be dyed, a ſtick is paſſed through each hank (which commonly weighs one pound) and they remain on the ſtick during the courſe of the work to prevent their entangling. This ſtick alſo enables the Dyer to return the hanks with more eaſe, by plunging each part ſucceſſively in the liquor, by which they take an equal dye; by raiſing the hank with the ſtick, and drawing it half way out

out of the copper, feizing the other end of the hank with the other hand, it is plunged towards the bottom. If the wool be too hot, this may be done with two fticks, and the oftener this is repeated, the more even will be the dye; the ends of the fticks are then placed on two poles to drain. Thefe poles are fixed in the wall above the copper.

Liquor for the Kermes.

While this prepared wool is draining, the copper is emptied, and frefh water put in, to which is added about a fifth of four water, four pounds of Roman allum grofsly powdered, and two pounds of red tartar. The whole is brought to boil, and that inftant the hanks are dipped in (on the fticks) which are to remain in for two hours, ftirring them continually one after the other after the method already laid down.

I muft in this place obferve, that the liquor in which the allum is put, when on the point of boiling fometimes rifes fo fuddenly that it comes over the copper, if not prevented by adding cold water. If, when it is rifing, the fpun wool is inftantly put in, it ftops it, and produces the fame effects as cold water.

The liquor does not rife fo fuddenly when there is a large quantity of tartar, as in the procefs; but when the allum is ufed alone, fometimes above half the liquor comes over the copper when it begins to boil, if not prevented by the method defcribed.

When the wool has boiled two hours in this liquor, it is taken out, left to drain, gently fqueezed, and put into a linen bag in a cool place for five or fix days and fometimes longer; this is called leaving the wool in preparation. This is to

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make it penetrate the better, and helps to augment the action of the falts, for as a part of the liquor always flies off, it is evident that the remaining, being fuller of faline particles, becomes more active, provided there remained a fufficient quantity of humidity; for the falts being chryftalized and dry, would have no more action.

I have dwelled much longer on this preparing liquor, and the method of making it, than I fhall in the fequel, as there are a great number of colours for which it is prepared pretty near in the fame proportion, fo that when this happens, I fhall flightly defcribe it, mentioning only the changes that are to be made in the quantity of allum, tartar, four water, or other ingredients.

After the fpun wool has been covered five or fix days, it is fitted to receive the dye. A frefh liquor is then prepared according to the quantity of wool to be dyed, and when it begins to be lukewarm, take 12 ounces of powdered kermes for each pound of wool to be dyed, if a full and well-coloured fcarlet is wanted. If the kermes was old and flat, a pound of it would be required to each pound of wool. When the liquor begins to boil, the yarn (ftill moift, which it will be if it has been well wrapped in the bag, and kept in a cool place) is put in. If it had been boiled a long time before and grown dry, it muft be lightly paffed through lukewarm water, and well fqueezed before it is dyed.

Previous to its being dipped in the copper with the kermes, a handful of wool is caft in, which is let to boil for a minute: this takes up a kind of black fcum, which the kermes caft up, by which the wool that is afterwards dipped acquires a finer colour. This handful of wool being taken out, the prepared is to be put in. The hanks are paffed

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on ſticks as in the preparation, continually ſtirring, and airing them one after the other. It muſt boil after this manner an hour at leaſt, then taken out and placed on the poles to drain, afterwards wrung and waſhed.

The dye ſtill remaining in the liquor, may ſerve to dip a little freſh parcel of prepared wool; it will take ſome colour in proportion to the goodneſs and quality of the kermes put into the copper.

When different ſhades are wanted, a leſs quantity of kermes is uſed, ſo that for twenty pounds of prepared wool ſeven or eight are ſufficient.

The quantity of wool that is to have the lighteſt ſhade is firſt to be dipped, and to remain no longer in than the time ſufficient to turn it and make it take the dye equally. Then the next deepeſt ſhade intended is dipped, and left to remain ſome time longer; after this manner the work is continued to the laſt, which is left as long as requiſite to acquire the neceſſary ſhade.

The reaſon of working the lighteſt ſhades firſt, is, that if the yarn is left too long in, no damage is done, as that hank may ſerve for a deeper ſhade; whereas, if they begin by a deeper, there would be no remedy if a failure happened in ſome of the lighter ſhades. The ſame caution is to be taken in all colours whoſe ſhades are to be different.

There are ſeldom more ſhades than one from the colour now ſpoken of; but as the working part is the ſame for all colours, what has been ſaid on this ſubject will ſerve for the reſt.

The yarn thus dyed, before bringing it to the river, may be paſſed through lukewarm water, in which a ſmall quantity of ſoap has been perfectly diſſolved; this gives a brightneſs to the colour, but at the ſame time ſaddens it a little, that is, gives it a little caſt of the crimſon. As I ſhall often

make

make uſe of the terms *rouzing* and *ſaddening*, eſpecially in the acids, it is neceſſary to explain their meaning.

Saddening, is giving a crimſon or violet caſt to red; ſoap and alkaline ſalts, ſuch as ley of aſhes, pot-aſhes, lime, ſadden reds; thus they ſerve to bring them to the ſhade required when too bright, and that they are too much rouzed.

Rouzing, is doing quite the reverſe; it is giving a fire to the red, by making it border on the yellow or orange. This is performed on wool by the means of acids, as red or white tartar, cream of tartar, vinegar, lemon juice, and aqua fortis. Theſe acids are added more or leſs, according to the depth of the orange colour required. For example, if the ſcarlet of grain was wanted to be more bright, and to approach ſomewhat nearer to common ſcarlet, a little of the ſcarlet compoſition, which ſhall be ſpoken of, muſt be poured into the liquor after the kermes is put in, and the brown colour of that liquor would immediately be brightened by the acid, and become of a brighter red; the wool dipped in would be more liable to be ſpotted by mud and acid liquors: the reaſon will appear in the next chapter.

I have made various experiments on this colour, in order to make it fitter and brighter than what it generally is, but I never could extract a red that was to be compared to that of cochineal.

Of all the liquors which I made for the preparation of the wool, that which was made with the preparations juſt mentioned ſucceeded beſt. By changing the natural dye of the kermes, by different kinds of ingredients of metallic ſolutions, &c. various colours are made, which I ſhall immediately ſpeak of.

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I ſhall ſay but little about dying ſtuffs with this red, as the proportion cannot be preſcribed for each yard of ſtuff, on account of their breadth and thickneſs, or the quantity of wool entering their compoſition; practice alone will teach the neceſſary quantity for each ſort of ſtuff; however, not to work in the dark, or to try experiments at random, the ſureſt way will be to weigh the ſtuffs, and to diminiſh about one fourth part of the colouring ingredients laid down for ſpun wool, as ſtuffs take up leſs colour inwardly, their texture being more compact, prevents its penetration, whereas yarn or wool in the fleece receives it equally within and without.

The allum and tartar for the liquor of preparation for the ſtuffs muſt be diminiſhed in the ſame proportion, and they are not to remain in the preparing liquor as long as the wool. It may be dyed the next day after boiling.

If wool in the fleece is dyed with the red of the kermes, either to incorporate it with cloths of a mixed colour, or to make full cloths, it will have a much finer effect than if the wool had been dyed in the red of madder. I ſhall mention this in deſcribing the compound colours in which the kermes is uſed, or ought at leaſt to be uſed in preference to madder, which does not give ſo fine a red, but, being cheaper, is commonly ſubſtituted for it.

Half-grain ſcarlet, or baſtard ſcarlet, is that which is made of equal parts of kermes and madder. This mixture affords a very holding colour, not bright but inclining to a blood red. It is prepared and worked in the ſame manner as that made of kermes alone. This dye is much cheaper, and the Dyers commonly make it leſs perfect by diminiſhing the kermes and augmenting the madder.

By

By the proofs that have been made of ſcarlet of grain, or kermes, whether by expoſing it to the ſun, or by different proofs, it is certain there is not a more holding or a better colour; yet the kermes is no where in uſe but at Venice. The mode of this colour has been entirely out ſince the making of flame-coloured ſcarlets. This ſcarlet of grain is now called a colour of bullock's blood; nevertheleſs, it has great advantages over the other, for it neither blackens nor ſpots, and greaſe may be taken out without prejudice to its colour; but it is out of faſhion, and that is ſufficient. This has entirely put a ſtop to the conſumption of kermes in France. Scarce a Dyer knows it, and when Monſieur Colbert wanted a certain quantity for the experiments above related, he was obliged to ſend for it to Languedoc, the merchants of Paris keeping only a ſufficiency for medicinal purpoſes.

When a Dyer is obliged to dye a piece of cloth, known yet under the name of ſcarlet of grain, as he has neither the knowledge of the kermes, nor the cuſtom of uſing it, he makes it of a cochineal, as I ſhall relate in the following chapter; it comes cheaper, and is leſs holding than that made of the kermes. The ſame is done in regard to ſpun wool deſigned for tapeſtries, and as this ſhade is pretty difficult to hit with cochineal, they commonly mix brazil wood, which hitherto has been a falſe ingredient, permitted only in the leſſer dye. For this reaſon all theſe kind of reds fade in a very ſhort time, and though they are much brighter than required, coming out of the hands of the workman, they loſe all their brightneſs before the expiration of a year; they whiten or become exceeding grey; it is therefore to be wiſhed that the uſe of kermes was again eſtabliſhed. It is alſo certain, that if ſome Dyer ſet about uſing it, there are ſeveral co-

lours that might be extracted from it with more eaſe and leſs expence than the common method; for theſe colours would be better and more holding, and he would thereby acquire a greater reputation. I have made above fifty experiments with the kermes, from which ſome uſe in practice may ariſe; I ſhall only relate ſuch as have produced the moſt ſingular colours.

By mixing the kermes with cream of tartar, without allum, and as much of the compoſition as would be uſed for the making a ſcarlet with cochineal, you have in one liquor an exceeding bright cinnamon, for nothing but the acid entering in the mixture, the red parts of the kermes become ſo minute that they almoſt eſcape the ſight. But if this cinnamon colour be paſſed through a liquor of Roman allum, part of the red appears again; whether it be by the addition of the allum that drives out a part of the acid of the compoſition, or the earth of the allum precipitated by the attrition of the kermes, which has the effect of galls, I know not; but this red thus reſtored is not fine.

With cream of tartar (the compoſition for ſcarlet) and allum, in greater quantity than tartar, the kermes gives a lilach colour, which varies according as the proportion of ingredients are changed.

If in the place of allum and tartar, ready prepared tartar of vitriol is ſubſtituted, which is a very hard ſalt, reſulting from the mixture of the vitriolic acid and a fixed alkali, ſuch as the oil of tartar, pot-aſhes, &c. and if, I ſay, after boiling the kermes in a ſolution of a ſmall quantity of this ſalt, the ſtuff be dipped in and boiled one hour, it acquires a tolerable handſome agath grey, and in which very little red is ſeen, for the acid of the compoſition having too much divided the red of the kermes, and the tartar of vitriol, not containing the earth of the allum,

allum, it could not re-unite these red atoms, dispersed by precipitation. These agath greys are of the good dye, for, as I have observed in the chapter treating of indigo, the tartar of vitriol is a hard salt, which is not calcined by the sun, and is indissoluble in rain water.

Glauber salts mixed with the kermes entirely destroy its red, and give an earthy grey that does not stand the proof, for this salt neither resists cold water nor the rays of the sun, which reduce it into powder. Vitriol or green copperas, and blue vitriol separated substituted for allum, but joined to the chrystal of tartar, equally destroy or veil the red of the kermes, which in these two experiments produce the same effect as if galls or sumach had been made use of; for it precipitates the iron of the green vitriol, and dyes the cloth of a grey brown, and the copper of the blue vitriol dyes it of an olive.

Instead of blue vitriol, I used a solution of copper * in aqua fortis, which also produced an olive colour; a convincing proof that the kermes has the precipitating quality of the galls, since it precipitates the copper of the vitriol as a decoction of gall-nut would.

There is great probability that what renders the red of the kermes as holding as that of madder, is from the insects feeding on an astringent shrub, which, notwithstanding the changes made by the digestion of the juices of the plant, still retains the astringent quality of the vegetable, and consequently the virtue, and so gives a greater spring to the pores of the wool to contract themselves quicker and with greater strength, when it comes out of the boiling water, and is exposed to the cold air; for I have

 observed

* Verdigrise.

observed that all barks, roots, woods, fruits, and other matters that have some astriction, yield colours of the good dye.

Violets without Blue.

The white vitriol of goslar, whose basis is the zinck, being joined with the chrystal of tartar, changes the red of the kermes into a violet. Thus with one colouring ingredient, and simple changes, violets are made without a blue ground; for this compound colour, hitherto only obtained by putting a blue on a red, or a red on a blue, is made as well with cochineal, or even with madder, as shall be shewn treating of these two ingredients. White vitriol being extracted from a mine, containing lead, arsenic, and several other matters, whose recrements melted afterwards with sand and alkaline salts, vitrifies into a blue mass, called *safre*. I suspected the white vitriol might contain a portion of this blue, which, with the red of the kermes, might have changed to a violet, and consequently that the mine of the bismuth, which really contains this blue matter, and the bismuth itself, would produce the same effect as white vitriol; neither was I mistaken in my conjecture; for having put some of the extract of the mine of dismuth in the liquor of kermes, and some of the solution of the bismuth itself, upon another decoction of the same ingredient, they both dyed cloth of a violet colour. I shall not here give the process of extracting the mine of bismuth, for it is a difficult operation for a Dyer. However, if the reader is desirous to know what I mean by the extraction of the mine of bismuth, he will find the process in the Royal Academy of Sciences for the year 1737, where there is a memoir on sympathetic inks. As to the solution

of

of bifmuth, which produces almoft the fame effect, it is made after the following manner:

Take four parts of fpirits of nitre, and four parts of very clear water, which mix together, and diffolve therein one part of bifmuth, or tin glafs, broken in fmall pieces, put the laft little by little into the liquor, left they fhould occafion too violent a fermentation. Acids put in too great abundance in the liquor of the kermes, whether it be fpirits of vitriol, aqua fortis, vinegar, lemon juice, even four water, fo greatly divide the red colouring particles, that the cloth receives but a cinnamon colour, bordering on the aurora, if there is too much acid, and a little redder if there is lefs.

Fixed alkaline falts, mixed with four water and cream of tartar, in the place of allum, do not deftroy the red of the kermes as acids do, but faddens and muds it if too much be put in, fo that the cloth receives only a faded lilach colour.

Other experiments, ftill more diverfified than thofe here related, prefented an infinite variety of colours, but nothing more beautiful than what may be done with cheaper drugs than the kermes; I fhall therefore pafs them over.

CHAP. X.

Of FLAME-COLOURED SCARLET.

FLAME-coloured fcarlet, that is, bright-coloured fcarlet, known formerly under the name of Dutch fcarlet, (the difcovery of which Kunkel attributes to Kufter, a German chymift) is the fineft and brighteft colour of the dye. It is alfo the moft coftly, and one of the hardeft to bring to perfection. It is not eafy to determine the point of perfection,

for, independent of different taſtes concerning the choice of colours, there are alſo general fancies, which make certain colours more in faſhion at one time than another; when this happens, faſhionable colours become perfect ones. Formerly ſcarlets were choſen full, deep, and of a degree of brightneſs which the ſight eaſily bore. At this time they muſt be on the orange, full of fire, and of a brightneſs which dazzles the eye. I ſhall not decide which of theſe two faſhions deſerve the preference, but ſhall give the method of making them both, and all the ſhades which hold a medium between theſe extremes.

Cochineal, which yields this beautiful colour, and is alſo called meſtick, or teſcalle, is an inſect that is gathered in great quantities in Mexico. The natives and Spaniards, who have but ſmall eſtabliſhments there, cultivate them, that is, carefully gather them from the plant on which they feed before the rainy ſeaſon. They kill and dry thoſe deſigned for ſale, and preſerve the reſt to multiply when the bad ſeaſon is over. This inſect feeds and breeds upon a kind of prickly opuntia, which they call topal. It may be preſerved in a dry place for ages without ſpoiling.

The cochineal ſylveſtre, or campeſſiane, is alſo brought from Vera-Cruz. The indians of Old and New Mexico gather this kind in the woods; it feeds, grows, and generates there on the wild uncultivated opuntias; it is there expoſed in the rainy ſeaſon to all the humidity of the air, and dies naturally. This cochineal is always ſmaller than the fine or cultivated; the colour is more holding and better, but has not the ſame brightneſs, neither is it profitable to uſe it, ſince it requires four parts, and ſometimes more, to do what may be done with one of fine.

Sometimes

Sometimes they have damaged cochineal at Cadiz; this is fine cochineal that has been wetted with salt water, occasioned by some shipwreck or leakage. These accidents considerably diminish the price, the sea salt saddening the dye. This kind serves only to make purples, and even those are not the best. However, a person in 1735 found the secret to turn this to almost as much advantage for scarlet as the finest cochineal. The discovery of this secret is easy, but let him that possesses it enjoy it, I shall not deprive him of the advantage he might have in it.

Every Dyer has a particular receipt for dying scarlet, and each is fully persuaded that his own is preferable to all others; yet the success depends on the choice of the cochineal, of the water used in the dye, and on the manner of preparing the solution of tin, which the Dyers call composition for scarlet.

As it is this composition which gives the bright flame colour to the cochineal dye, and which without this acid liquor would naturally be of a crimson colour, I shall describe the preparation that succeeded best with me.

Composition for Scarlet.

Take eight ounces of spirit of nitre (which is always purer than the common aqua fortis mostly used by the Dyers) and * be certain that it contains

* Dissolve in a small quantity of spirit of nitre as much silver as it will take; put a few drops of this into some of the spirit of nitre that is to be proved; if this spirit remains transparent, it is pure; but if a white cloud be perceived, which will afterwards form a sediment, it is a sign that there is a commixture of vitriol or spirit of salt. In order therefore to render the spirit of nitre absolutely pure, drop the solution of silver gradually into it, so long as

tains no vitriolic acid; weaken this nitrous acid by putting into it eight ounces of filtered river water; diſſolve in it, little by little, half an ounce of very white ſalt ammoniac, to make it an aqua regia, becauſe ſpirits of nitre alone will not diſſolve block-tin. Laſtly, add two drachms of ſaltpetre; this might be omitted, but I obſerved that it was of uſe in making the dye ſmooth and equal. In this aqua regia thus weakened, diſſolve one ounce of the beſt block-tin, which is firſt granulated or made ſmall while melted by caſting it from a height into a veſſel of cold water. Theſe ſmall grains of tin are put into the diſſolvent one by one, letting the firſt diſſolve before putting in others; this prevents the loſs of the red vapours, which would riſe in great abundance, and be loſt if the diſſolution of the metal was made too haſtily; it is neceſſary to preſerve theſe vapours, and, as Kunkel obſerved, they greatly contribute towards the brightneſs of the colour, either becauſe theſe vapours are acids that evaporate and are loſt, or contain a ſulphur peculiar to ſaltpetre, which gives a brightneſs to the colour. This method is indeed much longer than that uſed by the Dyers, who immediately pour the aqua fortis upon the tin reduced to ſmall pieces, and wait till a ſtrong fermentation enſues, and a great quantity evaporates before they weaken it with common watet. When the tin is thus diſſolved, this ſcarlet compoſition is made, and the liquor is of the beautiful colour of diſſolved gold, without any dirt or black ſediment,

as

as it ſhall produce the leaſt turbidneſs, time being given for the ſpirit to become clear betwixt each addition. The ſpirit of nitre being then poured off from the ſediment will be perfectly pure; and if this ſediment, which is the ſilver precipitated, be evaporated to dryneſs, and then infuſed in a crucible with a ſmall quantity of any fixed alkaline ſalt, it will be reduced to its proper metalline ſtate.

as I used very pure tin without allay, and such as runs from the first melting of the furnaces of Cornwall. This solution of tin is very transparent when newly made, and becomes milky and opaque during the great heat of summer; the greatest part of the Dyers are of opinion, that it is then changed and good for nothing; yet mine, notwithstanding this defect, made as bright scarlet as if it had remained clear; besides, in cold weather, what I made recovered its first transparency. It must be kept in a glass bottle with a stopper, to prevent the evaporation of the volatile parts.

As the Dyers do not attend to this, their composition often becomes useless at the end of twelve or fifteen days. I have laid down the best method, and if they seek perfection, they will abandon their old practice, which is imperfect.

The Dyers in France first put into a stone vessel, with a large opening, two pounds of salt ammoniac, two ounces of refined saltpetre, and two pounds of tin reduced to grains by water, or, which is still preferable, the filings of tin; for when it has been melted and granulated, there is always a small portion converted into a calx which does not dissolve. They weigh four pounds of water in a separate vessel, of which they pour about two ounces upon the mixture in the stone vessel; they then add to it a pound and a half of common aqua fortis, which produces a violent fermentation. When the ebullition ceases, they put in the same quantity of aqua fortis, and an instant after they add one pound more. They then put in the remainder of the four pounds of water they had set aside; the vessel is then close covered, and the composition let to stand till the next day.

The salt petre and salt ammoniac are sometimes dissolved in the aqua fortis before the tin is put in;

they

they practice both methods indiscriminately, though it is certain that this last method is best. Others mix the water and aqua fortis together, and pour this mixture on the tin and salt ammoniac. In short, every Dyer follows his own method.

Water for the Preparation of Scarlet.

The day after preparing the composition, the water for the preparation of scarlet is made, which differs from that made in the preceding chapter.

Clear the water well. For each pound of spun wool, put twenty quarts of very clear river water (hard spring water will not do) into a small copper. When the water is a little more than lukewarm, two ounces of cream of tartar finely powdered, and one drachm and a half of powdered and sifted cochineal is added. The fire is then made a little stronger, and when the liquor is ready to boil, two ounces of the composition are put in. This acid instantly changes the colour of the liquor, which, from a crimson, becomes of the colour of blood.

As soon as this liquor begins to boil, the wool is dipped in, which must have been previously wetted in warm water and wrung. The wool is continually worked in this liquor, and left to boil an hour and a half; it is then taken out, slightly wrung, and washed in fresh water. The wool coming out of the liquor is of a lively flesh colour, or even some shades deeper, according to the goodness of the cochineal, and the strength of the composition. The colour of the liquor is then entirely passed into the wool, remaining almost as clear as common water.

This is called the water of preparation for scarlet, and the first preparation it goes through before it is dyed; a preparation absolutely necessary, without

without which the dye of the cochineal would not be ſo good.

Reddening.

To finiſh it, a freſh liquor is prepared with clear water, the goodneſs of the water being of the greateſt importance towards the perfection of the ſcarlet. An ounce and a half of ſtarch is put in*, and when the liquor is a little more than lukewarm, ſix drachms and a half of cochineal finely powdered and ſifted is thrown in. A little before the liquor boils, two ounces of the compoſition is poured in, and the liquor changes its colour as in the former. It muſt boil, and then the wool is put into the copper, and continually ſtirred as in the former. It is likewiſe boiled an hour and a half; it is then taken out, wrung, and waſhed. The ſcarlet is then in its perfection.

One ounce of cochineal is ſufficient for a pound of wool, provided it be worked with attention, and after the manner laid down, and that no dye remains in the liquor. For coarſe cloth leſs would do, or half as much for worſted. However, if it was required to be deeper of cochineal, a drachm or two might be added, but not more, for it would then loſe its luſtre and brightneſs.

Though I have mentioned the quantity of the compoſition, both in the water of the preparation and the dye, yet this proportion is not to be taken as a fixed rule.

The aqua fortis, uſed by the Dyers, is ſeldom of an equal ſtrength; if, therefore, it be always mixed with an equal quantity of water, the compoſition would not produce the ſame effect; but there is a method of aſcertaining the degree of

acidity

* Starch ſoftens it.

acidity of aqua fortis. For example, to use that only, two ounces of which would dissolve one ounce of silver. This would produce a composition that would be always equal, but the quality of the cochineal will then produce new varieties, and the trifling difference that this commonly causes in the shade of scarlet is of no great signification, as more or less may be used to bring it precisely to the colour desired. If the composition be weak, and the aforesaid quantity not put in, the scarlet will be a little deeper and fuller in colour. On the contrary, if a little more is added, it will be more on the orange, and have what is called more fire; to rectify which, add a little of the composition, stirring it well in the copper, having first taken out the wool, for if it was to touch any part before it was thoroughly mixed, it would blot it. If, on the contrary, the scarlet has too much fire, that is, too much on the orange, or too much reversed, it must be passed through clear warm water; when finished, this saddens it a little, that is, diminishes its bright orange; if there still remained too much, a little Roman allum must be mixed with the hot water.

For spun wool that is to have all the various shades of scarlet, about half the cochineal, and half the composition for full scarlet is sufficient. The cream of tartar must also be diminished proportionably in the water of preparation. The wool must be divided into as many hanks or skains as there are to be shades, and when the liquor is prepared, the skains that are to be lightest are first to be dipped, and to remain in but a very short space of time; then those that are to be a little deeper, which must remain in somewhat longer, and thus proceeding to the deepest; the wool is then to be washed, and the liquor prepared to finish them. In this liquor, each of these shades are to be boiled

one

one after the other, beginning always with the lighteſt, and if any are perceived not to be of the proper ſhade, they muſt be paſſed again through the liquor. The eye of a Dyer will readily judge of the ſhades, and a little practice will bring this to perfection.

The Dyers are divided in opinion of what metal the boiler ſhould be made. In Languedoc they uſe thoſe made of the fineſt block-tin, and ſeveral Dyers in Paris follow the ſame method. Yet that great Dyer, M. de Julienne, whoſe ſcarlets are in high repute, uſes braſs. The ſame is uſed in the great manufactory at St. Dennis. M. de Julienne, to keep the ſtuffs from touching the boiler, makes uſe of a large rope-net with cloſe maſhes. At St. Dennis, inſtead of a rope-net, they have large baſkets, made of willow ſtripped of the bark, and not too cloſe worked.

As ſo much had been ſaid concerning the metal of the boiler, I tried the experiment. I took two ells of white ſedan cloth, which I dyed in two ſeparate boilers of equal ſize; one was of braſs, fitted with a rope net, the other of block-tin. The cochineal, the compoſition, and other ingredients, were weighed with the utmoſt accuracy, and boiled preciſely the ſame time. In ſhort, I took all poſſible care that the proceſs ſhould be the ſame in both, that if any difference aroſe it might only be attributed to the different metals of the boiler. After the firſt liquor, the two pieces of cloth were abſolutely alike, only that which had been boiled in the tin veſſel appeared a little more ſtreaked and uneven, which, in all likelihood, proceeded from theſe two ells of cloth being leſs ſecured at the mill than the two others; the two pieces were finiſhed each in the ſeparate boilers, and both turned out very fine; but that which had been made in the tin

boiler had a little more fire than the other, and the laſt was a little more ſaddened. It would have been an eaſy matter to have brought them both to the ſame ſhade, but that was not my intention.

From this experiment, I conclude, that when a braſs boiler is uſed, it requires a little more of the compoſition than the tin one; but this addition of the compoſition makes the cloth feel rough; to avoid this defect, the Dyers who uſe braſs veſſels put in a little turmeric, a drug of the dye, but which gives to ſcarlet that ſhade which is now in faſhion; I mean that flame-colour, which the eye is ſcarce able to bear.

This adulteration is eaſily diſcovered by cutting a piece of the cloth; if there is no turmeric, the web will be of a fine white, but yellow if there is. When the web is dyed the ſame as the ſurface, it is ſaid that colour is webbed,and the contrary, when the middle of the weaving remains white. The lawful ſcarlet is never dyed in the web: the adulterated, where the turmeric or fuſtic has been made uſe of, is more liable to change its colour in the air than the other. But as the brighteſt ſcarlets are now in faſhion, and muſt have a yellow caſt, it is better to tolerate the uſe of turmeric, than to uſe too great a quantity of the compoſition to bring the ſcarlet to this ſhade; for in this laſt caſe, the cloth would be damaged by it, would be ſooner ſpotted by dirt from the quality of the acid, and would be more eaſily torn, becauſe acids ſtiffen the fibres of the wool, and render them brittle.

I muſt alſo take notice, that if a copper veſſel is uſed it cannot be kept too clean. I have failed ſeveral times with my patterns of ſcarlet, by not having the copper ſcoured.

I cannot help condemning the common practice of ſome Dyers, even the moſt eminent, who pre-

pare

pare their liquor over-night, and keep it hot till next morning, when they dip in their ſtuffs; this they do not to loſe time, but it is certain that the liquor corrodes the copper in that ſpace, and by introducing particles of copper in the cloth, prejudices the beauty of the ſcarlet. They may ſay they only put in their compoſition juſt at the time when the cloth is ready to be dipt in the copper; but the cream of tartar, or the white tartar, which they put in over-night, is an acid ſalt ſufficient to corrode the copper of the veſſel, and form a verdigriſe, although it dilutes itſelf as it forms, ſtill has not a leſs effect.

It would therefore be better to make uſe of tin boilers, a boiler of this metal muſt contribute to the beauty of ſcarlet; but theſe boilers of a ſufficient ſize coſt much, and may be melted by the negligence of the workmen, and there is a difficulty in caſting them of ſo great a ſize without ſand-flaws, which muſt be filled. Now if theſe ſand-holes are filled with ſolder, there muſt of neceſſity be places in the boiler that contain lead; this lead in time being corroded by the acid of the compoſition, will tarniſh the ſcarlet. But if ſuch a boiler could be caſt without any ſand-holes, it is certain ſuch a one would be preferable to all others, as it contracts no ruſt, and if the acid of the liquor detaches ſome parts, they cannot be hurtful.

Having laid down the manner of dying ſpun wool in ſcarlet, and its various ſhades, which are ſo neceſſary for tapeſtry and other work, it is proper to give an idea of the dying of ſeveral pieces of ſtuff at one time. I ſhall relate this operation as it is practiſed in Languedoc. I made the trial on ſome ells of ſtuff, which ſucceeded very well, but this ſcarlet was not ſo fine as the flame-coloured.

There are two reaſons why the wool is not dyed before it is ſpun (for fine colours) firſt in the courſe of the manufacturing, that is, either in the ſpinning, carding, or weaving, it would be almoſt impoſſible in a large workſhop, where there are many workmen, but that ſome particles of white wool, or ſome other colour would mix, which would ſpoil that of the ſtuff by blotting it ever ſo little; for that reaſon, the reds, the blues, the yellows, the greens, and all other colours that are to be perfectly uniform, are never dyed before they are maufactured.

The ſecond reaſon, which is peculiar to ſcarlet, or rather to cochineal, is, that it will not ſtand the milling, and as the greateſt part of high ſtuffs muſt be milled after they are taken from the loom, the cochineal would loſe part of its colour, or at leaſt would be greatly ſaddened by the ſoap, which produces this effect by the alkaline ſalt which deſtroys the brightneſs given to the red by the acid. Theſe are the reaſons that the cloths and ſtuffs are not dyed in ſcarlet, light red, crimſon, violet, purple, and other light colours, but after being entirely milled and dreſſed.

To dye, for example, five pieces of cloth at one time of five quarters breadth, and containing fifteen or ſixteen ells each, the following proportions are to be obſerved. Put into a ſtone or glazed earthen pot twelve pounds of aqua fortis, and twenty pounds of water, to which add a pound and a half of tin, made in grains by running it in water, or filed. The diſſolution is made quicker or ſlower, according to the greater or leſſer acidity of the aqua fortis. The whole is left to reſt twelve hours at leaſt, during which time a kind of black mud ſettles at the bottom of the veſſel; what ſwims over this ſediment is poured off by inclination; this liquor is clear

clear and yellow, and is the compoſition which is to be kept by itſelf.

This proceſs differs from the firſt in the quantity of water mixt with the aqua fortis, and in the ſmall quantity of tin, little of which muſt remain in the liquor, ſince aqua fortis alone cannot diſſolve it, but only corrodes it, and reduces it to a calx, as there is neither ſalt petre nor ſalt ammoniac which would form an aqua regia. However, the effect of this compoſition differs from the firſt only to the eyes accuſtomed to judge of that colour.

This compoſition made without ſalt ammoniac, and which has been of long uſe amongſt a great number of manufacturers at Carcaſſone, who certainly imagined that its effect was owing to the ſulphur of the tin, can only keep thirty-ſix hours in winter without ſpoiling, and twenty-four hours in ſummer; at the expiration of which it grows muddy, and a cloud precipitates to the bottom of the veſſel, which changes to a white ſediment. This is the ſmall quantity of tin, which was ſuſpended in the acid, but an acid not prepared for that metal; the compoſition which ought to be yellow becomes at that time as clear as water, and if uſed in that ſtate would not ſucceed; it would have the ſame effect as that which would become milky.

The late M. Baron pretended to have been the firſt diſcoverer at Carcaſſone of the neceſſity of adding ſalt ammoniac to hinder the tin from precipitating. If ſo, there was no one in that town that knew that tin cannot be really diſſolved but by aqua regia.

Having prepared the compoſition as I have deſcribed it after M. de Fondriers, about ſixty cubical feet of water are put into a large copper for the five pieces of cloth before mentioned, and when the water grows warm, a bag with bran is

put in, sometimes also four waters are used: the one and the other serve to correct the water, that is, to absorb the earthy and alkaline matters which may be in it, and which, as I have already said, saddens the dye of the cochineal, for the effect of the water ought to be well known, and experience will teach whether such expedients should be used, or whether the water, being very pure and denulated of salts and earthy particles, can be used without such helps.

Be that as it will, as soon as the water begins to be little more than lukewarm, ten pounds of powdered cream of tartar is flung in, that is, two pounds for each piece of cloth. The liquor is then raked strongly, and when it grows a little hotter, half a pound of powdered cochineal is cast in, which is well mixt with sticks; immediately after, twenty-seven pounds of the composition very clear is poured in, which is also well stirred, and as soon as the liquor begins to boil, the cloths are put in, which are made to boil strongly for two hours, stirring them continually by the help of the wynch; they are then taken out upon the scray, and well handled three or four times from end to end, by passing the lists between the hands to air and cool them. They are afterwards washed.

After the cloth has been washed, the copper is emptied and a fresh liquor prepared, to which, if necessary, a bag with bran or some four water is added; but if the water is of a good quality, these are to be omitted; when the liquor is ready to boil, eight pounds and a quarter of powdered and sifted cochineal is put in, which is to be mixed as equally as possible throughout the liquor, and having left off stirring, it is to be observed when the cochineal rises on the surface of the water, and forms a crust of the colour of the lees of the wine; the instant

this

this cruſt opens of itſelf in ſeveral places, eighteen or twenty pounds of the compoſition is to be added. A veſſel with cold water muſt be at hand to caſt on the liquor in caſe it ſhould riſe, as it ſometimes does, after the compoſition is put in.

As ſoon as the compoſition is in the copper, and equally diſtributed throughout the whole, the cloth is caſt in, and the wynch ſtrongly turned two or three times, that all the pieces may equally take the dye of the cochineal. Afterwards it is turned ſlowly to let the water boil, which it muſt do very faſt for one hour, always turning the wynch, and ſinking the cloth in the liquor with ſticks, when by boiling it riſes too much on the ſurface. The cloth is then taken out, and the liſts paſſed between the hands to air and cool it; it is then waſhed, after which it is to be dyed and dreſſed.

In each piece of the Languedoc ſcarlet cloth there is uſed, as has been ſhewn, one pound and three quarters of cochineal in the dye and preparation; this quantity is ſufficient to give the cloth a very beautiful colour. If more cochineal was added, and a deeper orange-colour required, the quantity of the compoſition muſt be augmented.

When a great quantity of ſtuffs are to be dyed in ſcarlet, a conſiderable profit ariſes by doing them together, for the ſame liquor ſerves for the ſecond dip which was uſed for the firſt. For example: when the five firſt pieces are finiſhed, there always remains in the liquor a certain quantity of cochineal, which in ſeven pounds may amount to twelve ounces; ſo that if this liquor be uſed to dye other ſtuffs, the cloths dipped in it will have the ſame ſhade of roſe colour as if they had been dyed in a freſh liquor with twelve ounces of cochineal; yet this quantity may vary pretty much, according to the quality or choice

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of the cochineal, or according to the fineneſs it has been reduced to when powdered. I ſhall ſay no more of this before I finiſh this chapter; but whatever colour may remain in the liquor, it deſerves ſome attention on account of the high price of this drug. The ſame liquor is then made uſe of for other five pieces, and leſs cochineal and compoſition are put in proportion to what may be judged to remain; fire and time are alſo ſaved by this, and roſe-colour and fleſh-colour may alſo be produced from it; but if the Dyers have not leiſure to make theſe different liquors in twenty-four hours, the colour of the liquor corrupts, grows turbid, and loſes the roſe-colour entirely. To prevent this corruption ſome put in Roman allum, but the ſcarlets which are prepared after that manner are all ſaddened.

When cloths of different qualities, or any other ſtuffs are to be dyed, the ſureſt method is to weigh them, and for each hundred weight of cloth add about ſix pounds of chryſtal or cream of tatrar, eighteen pounds of compoſition in the water of preparation, as much for the reddening, and ſix pounds and a quarter of cochineal. Thus in proportion for one pound of ſtuff uſe one ounce of cream of tartar, ſix ounces of compoſition, and one ounce of cochineal; ſome eminent Dyers at Paris put two-thirds of the compoſition and a fourth of the cochineal in the water of preparation, and the other third of the compoſition with three-fourths of the cochineal in reddening.

It is not cuſtomary to put cream of tartar in the reddening, yet I am certain, by experience, that it does not hurt, provided the quantity does not exceed half the weight of the cochineal, and it appeared to me to make a more laſting colour. Some Dyers have made ſcarlet with three dippings; namely,

namely, a firſt and ſecond water for preparation, and then the reddening; but ſtill the ſame quantity of drugs is always uſed.

I obſerved, in the foregoing chapter, that the little uſe made of kermes for the brown or Venetian ſcarlets, obliges moſt Dyers to make them with cochineal; for this purpoſe a water of preparation is made as uſual; and for the reddening, eight pounds of allum are added for each hundred weight of ſtuff; this allum is diſſolved by itſelf in a kettle, with a ſufficient quantity of water, then poured into the liquor before the cochineal is put in. The remainder is performed exactly as in the common ſcarlet; this is the Venetian ſcarlet, but it has not near the ſame ſolidity as if made with the kermes.

There are no alkaline ſalts which do not ſadden ſcarlet; of this number are the ſalt of tartar, potaſh, pearl-aſhes calcined, and nitre fixed by fire; therefore allum is more generally uſed; and if theſe alkaline ſalts be boiled with the ſtuffs, they would conſiderably damage them, for they diſſolve all animal ſubſtances. If the allum be calcined, it is ſtill the more ſecure.

The redder the ſcarlet is, the more it has been ſaddened; from thence it appears that theſe colours loſe in the liquor that browns them a part of their ground; however one cannot brown in the good dye but with ſalts. The late M. Baron obſerves, in a memoir he gave ſome time ago to the Royal Academy of Sciences, that all the ſalts he had made uſe of for browning, making the colour ſmooth, and preſerving its brightneſs and deepneſs, he had ſucceeded beſt with ſalt of urine, but, as he obſerves, it is too troubleſome to make this ſalt in any quantity.

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I ſaid, in the beginning of this chapter, that the choice of the water for dying of ſcarlet was very material, as the greateſt part of common water ſaddens it, for they moſtly contain a chalky, calcarious earth, and ſometimes a ſulphureous or vitriolic acid; theſe are commonly called hard waters, that is, they will not diſſolve ſoap or boil vegetables well. By finding a method of abſorbing or precipitating theſe hurtful matters, all waters may be equally good for this kind of dye: thus, if alkaline matters are to be removed, a little ſour water produces this effect; for if five or ſix buckets of theſe ſour waters are mixed with ſixty or ſeventy of the hard water before it comes to boil, theſe alkaline earths riſe in a ſcum, which is eaſily taken off the liquor.

All that I have hitherto ſaid in this chapter is for the inſtruction of Dyers; I ſhall now make an attempt to ſatisfy the philoſopher how theſe different effects are produced.

Cochineal, infuſed or boiled by itſelf in pure water, gives a crimſon colour bordering on the purple; this is its natural colour; put it into a glaſs, and drop on it ſpirits of nitre; this colour will become yellow, and if you ſtill add more, you will ſcarcely peceive that there was originally any red in the liquor; thus the acid deſtroys the red by diſſolving it and dividing its parts ſo minutely that they eſcape the ſight. If in this experiment a vitriolic, inſtead of a nitrous acid be uſed, the firſt changes of the colour will be purple, then purpled lilach, after that a light lilach, then fleſh-colour, and laſtly, colourleſs. This bluiſh ſubſtance, which mixes with the red to form a purple, may proceed from that ſmall portion of iron, from which oil of vitriol is rarely exempt. In the liquor of preparation for ſcarlet, no other ſalt but cream of tartar

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is uſed, no allum is added as in the common preparing water for other colours, becauſe it would ſadden the dye by its vitriolic acid; yet a calx or lime is required, which, with the red parts of the cochineal, may form a kind of lake like that the painters uſe, which may ſet in the pores of the wool by the help of the chryſtal of tartar.

This white calx is found in the ſolution of very pure tin, and if the experiment of the dye is made in any ſmall glazed earthen veſſel, immediately on the cochineal's communicating its tincture to the water, and then adding the compoſition drop by drop, each drop may be perceived with a glaſs or lens, to form a ſmall circle, in which a briſk fermentation is carried on; the calx of the tin will be ſeen to ſeparate, and inſtantaneouſly to take the bright dye, which the cloth will receive in the ſequel of the operation.

A further proof that this white calx of tin is neceſſary in this operation, is, that if cochineal was uſed with aqua fortis, or ſpirits of nitre alone, a very ugly crimſon would be obtained; if a ſolution of any other metal was made uſe of in ſpirits of nitre, as of iron or mercury, from the firſt would be had a deep cinder-grey, and from the ſecond, a cheſnut-colour with green ſtreaks, without being able to trace in the one or other any remains of the red of the cochineal. Therefore, by what I have laid down, it may be reaſonable to ſuppoſe, that the white calx of the tin, having been dyed by the colouring parts of the cochineal, rouzed by the acid of the diſſolvent of this metal, has formed this kind of earthy lake, whoſe atoms have introduced themſelves into the pores of the wool, which were opened by the boiling water, that they are there plaiſtered by the chryſtal of tartar, and theſe pores, ſuddenly contracting by the immediate cold the cloth was expoſed

expofed to by airing, that thefe colouring particles are found fufficiently fet in to be of the good dye, and that the air will take off the primitive brightnefs, in proportion to the various matters with which it is impregnated. In the country, for example, and particularly if the fituation be high, a fcarlet cloth preferves its brightnefs much longer than in great cities, where the urinous and alkaline vapours are more abundant. For the fame reafon, the country mud, which in roads is generally but an earth diluted by rain water, does not ftain fcarlet as the mud of towns where there are urinous matters, and often a great deal of diffolved iron, as in the ftreets of great cities, for it is well known that any alkaline matter deftroys the effect which an acid has produced on any colour whatfoever. And for the like reafon, if a piece of fcarlet is boiled in a ley of pot-afh, this colour becomes purple, and by a continuation of boiling it is entirely taken out; thus from this fixed alkali, and the chryftal of tartar, a foluble tartar is made, which the water diffolves and eafily detaches from the pores of the wool: all the maftic of the colouring parts is then deftroyed, and they enter into the leys of the falts.

I have tried feveral experiments on the dye of cochineal, to difcover what might be produced from the union of its red with other different matters, which generally are not efteemed colouring; but I fhall only relate here fuch as had the moft fingular effects.

Experiments on Cochineal Liquor.

Zinc diffolved in fpirit of nitre changes the red of cochineal to a flatey violet-colour.

The falt of lead, ufed inftead of cream of tartar, makes a lilach fomewhat faded; a proof that fome portion

portion of lead is joined to the colour of the cochineal.

Vitriolated tartar made with pot-aſh and vitriol deſtroys its red, and there only remains an agath grey.

Diſmuth diſſolved in ſpirit of nitre, weakened by an equal part of common water, and poured on the liquor of cochineal, gives the cloth a dove-grey, very beautiful and very bright.

A ſolution of copper in ſpirit of nitre not weakened, gives to the cochineal a dirty crimſon.

Cupullated ſilver, a cinnamon colour, a little on the brown.

Arſenic added to the liquor of cochineal, gives a brighter cinnamon than the preceding.

Gold diſſolved in aqua-regia gave a ſtreaked cheſnut, which made the cloth appear as if it had been manufactured with wool of different colours.

Mercury diſſolved with ſpirit of nitre, produces pretty near the ſame effect.

Glauber's ſalts alone deſtroys the red, like the vitriolated tartar, and produces like that an agath grey, but not of the good dye; becauſe this ſalt eaſily diſſolves even in cold water, and beſides it calcines in the air.

The fixed ſalt of urine gives a cinder-grey colour, where not the leaſt tincture of red is perceived, and like the foregoing is not of a good dye, for it is a ſalt that cannot form a ſolid cement in the pores of the wool, as it is ſoluble by the moiſture of the air.

Violet without Blue.

Laſtly, the extract of buſmuth changes the cochineal red to a purple, almoſt violet, as beautiful as if this red had been put on a cloth that had been previouſly dyed of a ſky-blue.

From theſe experiments it is evident, that the ſalts and metallic ſolutions yield particles which unite themſelves with the particles of the colouring ingredients uſed in dying, and which ſalts and particles contribute greatly to the tenacity of colours.

Before I finiſh this chapter on ſcarlet, I muſt add ſome obſervations which perhaps the reader may be be glad to know.

Neither the mud of the ſtreets nor ſeveral acrid matters can ſtain ſcarlet, if the ſpotted part is immediately waſhed with plain clean water and a clean cloth; but if the mud has had time to dry, then the ſpot appears of a violet black; this cannot be taken off but by a vegetable acid, ſuch as vinegar, lemon juice, or a warm ſolution of white tartar ſlightly loaded with ſalts; but if theſe acids are not made uſe of with precaution and ſkill in taking off the black ſpot, a yellow one will ſucceed; becauſe, as has been ſaid before, the acids rouze and even deſtroy the red of the cochineal.

But there are ſome for which the colour muſt be diſcharged, and the ſtuff dyed again. There are other ſalts beſides alkalis which will diſcharge the colour of ſcarlet; for if a piece of ſcarlet cloth be put into the water of preparation for that colour, it will loſe a great part of its colour, inſomuch, that if it was ſewed with two or three pieces of white cloth, it would be difficult after one hour's boiling to diſtinguiſh which was the ſcarlet from the others; but if it was boiled afreſh in a liquor of cochineal or in the reddening, it would regain its firſt colour.

Scarlets always loſe ſome part of their brightneſs in the dreſſing, for the dreſſing lays the hair, and forces the fibres to be almoſt parallel to the web. In this caſe the cloth has numerically leſs ſurface, and conſequently leſs rays of light are reflected from it. Beſides the extremity of the hair

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is always moſt penetrated with the dye which cauſes the brightneſs, and when it is laid on the cloth, the greateſt part of theſe points appear no more.

CHAP. XI.

Of CRIMSON.

CRIMSON, as I have already obſerved, is the natural colour of the cochineal, or rather, that which it gives to wool boiled with allum and tartar, which is the uſual water of preparation for all colours. This is the method which is commonly practiſed for ſpun wool; it is almoſt the ſame for cloths, as will be ſeen hereafter.

For each pound of wool, two ounces and a half of allum, and an ounce and a half of white tartar, are put into the copper. When the whole boils, the wool is put in, well ſtirred, and left to boil for two hours; it is afterwards taken out, ſlightly wrung, put into a bag, and left thus with its water, as for the ſcarlet in grain, and for all other colours.

For the dye a freſh liquor is made, in which three-fourths of an ounce of cochineal is added for each pound of wool. When the liquor is little more than luke-warm, the cochineal is put in, and when it begins to boil, the wool is caſt in, which is to be well ſtirred with ſticks; it is to remain thus for an hour; when taken out, wrung and waſhed.

If degrees of ſhades are required, (whoſe names are merely arbitrary) proceed, as has been already related for the ſcarlet, uſing but half the cochineal at firſt, and beginning with the lighteſt.

The beauty of crimſon conſiſts in its bordering as much as poſſible on the griſdelin, a colour between a grey and a violet. I made ſeveral trials to bring crimſon to a higher perfection than moſt Dyers have hitherto done, and indeed I ſucceeded ſo as to make it as fine as the falſe crimſon, which is always brighter than the fine.

This is the principle on which I worked. As all alkalis ſadden cochineal, I tried ſoap, barilla, pot-aſh, pearl-aſhes; all theſe ſalts brought the crimſon to the ſhade I wanted, but at the ſame time, they tarniſhed and diminiſhed its brightneſs. I then bethought myſelf to make uſe of volatile alkalis, and I found that the volatile ſpirit of ſalt ammoniac produced a very good effect; but this ſpirit inſtantly evaporated, and a pretty conſiderable quantity was uſed in the liquor, which greatly augmented the price of the dye.

I then had recourſe to another expedient which ſucceeded better, the expence of which is trifling. This was to make the volatile alkali of the ſalt ammoniac enter into the liquor, at the very inſtant that it comes out of its baſis; and to effect this, after my crimſon was made after the uſual manner, I paſſed through a freſh liquor, in which I had diſſolved a little of the ſalt ammoniac. As ſoon as the liquor was a little more than luke-warm, I flung in as much pot-aſh as I had before of ſalt ammoniac, and my wool immediately took a very brilliant colour.

This method even ſpares the cochineal; for this new liquor makes it riſe, and then leſs may be uſed than in the common proceſs; but the greateſt part of Dyers, even the moſt eminent, ſadden their crimſons with archil, a drug of the falſe dye.

Very beautiful crimſons are alſo made by boiling the wool as for the common ſcarlet, and then boiling

ing it in a ſecond liquor, with two ounces of allum and one ounce of tartar, for each pound of wool, leaving it one hour in the liquor. A freſh liquor is then prepared, in which ſix drachms of cochineal is put for every pound of wool. After it has remained an hour in this liquor, it is taken out, and paſſed immediately through a liquor of barilla and ſalt ammoniac. By this method, gradations of very beautiful crimſon ſhades are made by diminiſhing the quantity of the cochineal. It is to be obſerved, that in this proceſs there are but ſix drachms of cochineal to dye each pound of wool, becauſe in the firſt liquor a drachm and a half of cochineal is uſed for each pound. It is alſo neceſſary to remark, that, to ſadden theſe crimſons, the liquor of the alkaline ſalt and ſalt ammoniac be not made too hot, becauſe the ſeparation of the volatile ſpirit of this laſt ſalt would be too quick, and the cryſtal of tartar of the firſt liquor would loſe its proper effect by being changed, as I have already ſaid, into a ſoluble tartar.

The ſame operation may be done by uſing one part of the cochineal ſylveſtre inſtead of the fine cochineal, and the colour is not leſs beautiful, for commonly four parts of ſylveſtre have not more effect in dying than one part of fine cochineal. The ſylveſtre may be alſo uſed in dying ſcarlet, but with great precaution; it ſhould only be uſed in baſtard ſcarlets and half crimſons. I ſhall ſpeak of this when I treat of theſe colours in particular.

When a ſcarlet is ſpotted or ſpoiled in the operation by ſome unforeſeen accident, or even when the dye has failed, the common remedy is to make it a crimſon, and for that purpoſe, it is dipt in a liquor where about two pounds of allum are added for each hundred weight of wool. It is imme-

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diately plunged in this liquor, and left there until it has acquired the ſhade of the crimſon deſired.

Languedoc Crimſon.

I ſhall now ſhew the method they follow in Languedoc to make a very beautiful ſort of crimſon, or the cloths exported to the Levant, but which is not ſo much ſaddened as that which I have juſt ſpoken of, and which reſembles much more the Venetian ſcarlet. For five pieces of cloth the liquor is prepared as uſual, putting bran if neceſſary. When it is more than luke-warm, ten pounds of ſea ſalt are put, inſtead of cryſtal of tartar, and when it is ready to boil, twenty-ſeven pounds of the ſcarlet compoſition, made after the manner of carcaſſine already deſcribed, are poured in, and without adding cochineal the cloth is paſſed through this liquor for two hours, keeping it always turning with the wynch, and continually boiling. It is afterwards taken out, aired and waſhed; then a freſh liquor is made, with eight pounds and three quarters of cochineal powdered and ſifted, and when it is ready to boil, twenty-one pounds of compoſition are added; the cloth is boiled for three quarters of an hour with the common precautions, after which it is taken out, aired and waſhed: It is of a very fine crimſon, but very little ſaddened; if it is required to be more ſaddened, a greater quantity of allum is put into the firſt liquor of preparation, and in the ſecond leſs of the compoſition, the ſea ſalt is alſo added to this ſecond liquor; a little practice in this method will ſoon teach the Dyer to make all the ſhades that can properly be derived from crimſon.

Whenever cochineal has been uſed, there is found at the bottom of the reddening liquor a quantity

quantity of very brown ſediment, which is flung away with the liquor as uſeleſs. I examined it and found, that the liquor for the reddening of ſcarlet contained a precipitated calx of tin: I united this metal with a great deal of trouble; the remaining parts of this ſediment are the droſs of the white tartar, or of the cream of tartar, united with the groſs parts of the bodies of the cochineal, which is, as has already been ſaid, a ſmall inſect. I waſhed theſe little animal parts in cold water, and, by ſhaking this water, I collected, with a ſmall ſieve, what the agitation cauſed to riſe on the ſurface.

After this manner I ſeparated theſe light parts from the earthy and metallic; I dried them ſeparately, then levigated them with equal weight of freſh cryſtal of tartar; I boiled a portion with a little allum, and put in a pattern of white cloth, which boiled for three quarters of an hour, at the end of which it was dyed of a very beautiful crimſon.

This experiment having convinced me, that by powdering and ſifting the cochineal as is commonly practiſed, all the profit that might be extracted from this dear drug is not obtained, I thought proper to communicate this diſcovery to the Dyers, that they might avail themſelves of it by the method following.

Take one ounce of cochineal powdered and ſifted as uſual; mix with it a quarter of its weight of very white cream of tartar very cryſtalline and very airy; put the whole on a hard levigating ſtone, and levigate this mixture till it is reduced to an impalpable powder; make uſe of this cochineal thus prepared in the liquor, and in the reddening, ſubtracting from the cream of tartar which is to be uſed in the liquor, the ſmall quantity before uſed

used with the cochineal. What is put to the reddening, although mixed with a fourth of the same salt, does not prejudice its colour, it even appeared to me that it was more solid. Those that will follow this method will find that there is about a fourth more profit to be obtained by it.

The Natural Crimson in Grain.

In proportion for every pound of cloth or other things, take two ounces of tartar pure, and two ounces of allum; boil them with the goods an hour and a half; then rince the goods very well from the boiling. The kettle must be filled again with clear water and a few handfuls of bran put in, in order to take out the filth of the water, as well as to soften it. Scum the scurf off when it begins to boil, and put in an ounce of well-powdered grain, with one dram of red arsenic and one spoonful of burnt wine lees; this gives a pretty lustre; then wash and rince it well, and you have a most beautiful colour.

CHAP. XII.

SCARLET *of* GUM-LACQUE.

THE red part of the gum-lacque may be also used for the dying of scarlet, and if this scarlet has not all the brightness of that made of fine cochineal alone, it has the advantage of being more lasting.

The gum-lacque, which is in branches or small sticks and full of animal parts, is the fittest for dying.

ing. It muſt be red within, and its external parts of a blackiſh brown; it appears, by a particular examination made of it by M. Geoffroy ſome years ſince, that it is a ſort of a hive, ſomewhat like that of bees, waſps, &c.

Some Dyers make uſe of it powdered and tied in a linen bag; but this is a bad method, for there always paſſes through the cloth ſome rezinous portion of the gum, which melts in the boiling water of the copper, and ſticks to the cloth, where it becomes ſo adherent when cold, that it muſt be ſcraped off with a knife.

Others reduce it to powder, boil it in water, and after it has given all its colour, let it cool, and the rezinous parts fall to the bottom. The water is poured out, and evaporated by the air, where it often becomes ſtinking, and when it has acquired the conſiſtence of thick honey, it is put up into veſſels for uſe. Under this form it is pretty difficult juſtly to determine the quantity that is uſed; this induced me to ſeek the means of obtaining this tincture ſeparated from its rezinous gum, without being obliged to evaporate ſo great a quantity of water to have it dry, and to reduce it to powder.

I tried it with weak lime water, with a decoction of the heart of agaric, with a decoction of comfrey-root, recommended in an ancient book of phyſic; in all theſe the water leaves a part of the dye, and it ſtill paſſes too full of colour, and it ought to be evaporated to get all the dye; this evaporation I wanted to avoid, therefore I made uſe of mucilaginous or ſlimy roots, which of themſelves gave no colour, but whoſe mucilage might retain the colouring parts, ſo that they might remain with it on the filtre.

The great comfrey-root has, as yet, the beſt anſwered by intention: I uſe it dry and in a groſs

powder,

powder, putting half a dram to each quart of water, which is boiled a quarter of an hour, passing it through a hair sieve. It immediately extracts from it a beautiful crimson tincture; put the vessel to digest in a moderate heat for twelve hours, shaking it seven or eight times to mix it with the gum that remains at the bottom, then pour off the water that is loaded with colour in a vessel sufficiently large, that three-fourths may remain empty, and fill it with cold water: then pour a very small quantity of strong solution of Roman allum on the tincture; the mucilaginous or slimy dye precipitates itself, and if the water which swims on the top appears still coloured, add some drops of the solution of allum to finish the precipitation, and this repeat till the water becomes as clear as common water.

When the crimson mucilage or slime is all sunk to the bottom of the vessel, draw off the clear water, and filter the remainder; after which, dry it in the sun.

If the first mucilaginous water has not extracted all the colour of the gum-lacque, (which is known by the remaining of a weak straw colour) repeat the operation until you separate all the dye the gum-lacque can furnish; and as it is reduced to powder when dry, the quantity to be used in the dye is more exactly ascertained than by evaporating it to the consistence of an extract.

Good gum-lacque, picked from its sticks, yields, dried and powdered, but little more dye than one-fifth of its weight. Thus at the price it bears at present, there is not so great an advantage as many may imagine in using it in the place of cochineal; but to make the scarlet colour more lasting than it commonly is, it may be used in the first liquor or preparation, and cochineal for reddening.

If

If ſcarlet is made of gum-lacque, extracted according to the method here taught, and reduced to powder, a caution is to be taken in diſſolving it, which is uſeleſs when cochineal is uſed; that is, if it was put into the liquor ready to boil, the Dyer would loſe three quarters of an hour, before it would be diſſolved entirely; therefore for diſpatch, put the doſe of this dry tincture into a large earthen veſſel, or into one of tin, pour warm water on it, and when it is well moiſtened, add the neceſſary doſe of the compoſition for ſcarlet, ſtirring the mixture well with a glaſs peſtle. This powder, which was of a dirty deep purple, as it diſſolves takes fire-coloured red extremely bright; pour the diſſolution into the liquor, in which was previouſly put the cryſtal of tartar, and as ſoon as this liquor begins to boil, dip the cloth in, keeping it continually turning. The remaining part of the operation is the ſame as that of ſcarlet with cochineal: the extract of gum-lacque, prepared according to my method, yields about one-ninth more of dye than cochineal, at leaſt than that which I made uſe of for this compariſon.

If inſtead of the cryſtal of tartar and the compoſition ſome fixt alkaline ſalt or lime water is ſubſtituted, the bright red of the gum-lacque is changed into the colour of lees of wine, ſo that this dye does not ſadden ſo eaſily as that of cochineal.

If inſtead of theſe alteratives, ſalt ammoniac is uſed by itſelf, cinnamon or clear cheſnut colours are obtained, and that according as there is more or leſs of this ſalt. I have made twenty other experiments on this drug, which I ſhall not relate here, becauſe they produced none but common colours, and which may be eaſier had from ingredients of a lower price. My experiments were with

with a view of improving the red of the lacque, and the method I have here laid down to extract its colouring parts anſwers extremely well; the more ingredients that are diſcovered for ſcarlet, the leſs will be the coſt; for, although theſe experiments made on cochineal, lacque, and other drugs, may appear uſeleſs to ſome Dyers, they will not be ſo to others who ſtudy to improve this art *.

CHAP. XIII.

Of the COCCUS POLONICUS, *a colouring Inſect.*

THE *coccus polonicus* is a little round inſect, ſomewhat leſs than a coriander ſeed; it is found ſticking to the roots of the *polygonum cocciferum incanum flore majore perenni* of Ray, and which M. Tournefort has named *alchymilli gramineo folis majore flore*. According to M. Breyn, it abounds in the palatinate of Kiovia, bordering the Ukrania, towards the towns of Ludnow, Piatka, Stobdyzeze, and other ſandy places of Ukrania and Podolia, of Volhinia, of the grand duchy of Lithuania, and even in Pruſſia, towards Thorn.

Thoſe that gather them ſay, that immediately after the ſummer ſolſtice the coccus is ripe, and full of its purple juice. They hold in their hand a ſmall hollow ſhade, made in the ſhape of a ſhepherd's crook, which has a ſhort handle. With one hand they hold the plant, raiſing it out of the ground with the other, armed with this inſtrument; they then ſhake off theſe little inſects, and place the plant in the ſame hole in order to preſerve it.

Having

* The colouring parts of the gum-lacque may be extracted by common river water, by making it a little more than luke-warm, and incloſing the powdered lacque in a coarſe woollen bag.

Having ſeparated the coccus from the earth, which they do by a riddle made for that purpoſe, their chief care is, that it ſhould not change into a ſmall worm; for this purpoſe they ſprinkle it with vinegar, and ſometimes with very cold water; they then bring them to a warm place, or elſe expoſe them to the ſun to dry; without this, theſe inſects would deſtroy themſelves, and if they were dryed too precipitately, they would loſe their beautiful colour. Sometimes they ſeparate theſe ſmall inſects from their veſicles or bladders with the ends of their fingers by a gentle preſſure, which they form into ſmall round cakes. The Dyers pay dearer for this dye when in lump than when it is in grain.

Bernard de Bernitz, from whoſe book I have taken this, adds, that the great marechal Konitspoliki, and ſome other Poliſh noblemen, who had lands in the Ukrania, ſet this gathering of the coccus to the Jews at a conſiderable profit, and cauſed it to be gathered by their vaſſals; that the Turks and Arminians, who bought this drug of the Jews, uſed it for the dying of wool, ſilk, the manes and tails of their horſes; that the Turkiſh women made uſe of it to paint their fingers' ends of a beautiful carnation colour; and that formerly the Dutch uſed to buy the coccus at a high price, and mixed it with an equal quantity of cochineal; that with the dye of this inſect and chalk, a lacque for the painters might be made as fine as the Florence lacque; and that a beautiful red was prepared from it for the toilet of the ladies in France and Spain.

C H A P. IV.

Of the RED *of* MADDER.

THE root of madder is the only part of this plant which is used in dying. Of all the reds this is the most lasting, when it is put on a cloth or stuff that is thoroughly scoured, then prepared with the salts with which it is to be boiled two or three hours, without which, this red, so tenacious after the preparation of the subject, would scarcely resist more the proofs of the reds than any other ingredients of the false dye. This is a proof that the pores of the fibres of the wool ought not only to be well scoured from the yolk or unctuous transpiration of the animal, which may have remained, notwithstanding the scouring of the wool after the common manner with water and urine; but it is also necessary, that these same pores be plaistered inwardly with some of those salts which are called hard, because they do not calcine in the air, and cannot be dissolved by rain-water, or by the moisture of the air in rainy weather. Such is, as has been said before, the white crude tartar, the red and the crystal of tartar, of which, according to common custom, about a fourth is put into the preparing liquor, with two-thirds or three-fourths of allum.

The best madder roots come generally from Zealand, where this plant is cultivated in the islands of Tergoés, Zerzée, Sommerdyke, and Tholen. That from the first of these islands is esteemed the best; the soil is clay, fat, and somewhat salt. The lands that are deemed the best for the cultivation of this plant are new lands, that only served for pasture, which are always fresher and moister than others. The Zealanders are beholden to the re-

fugees

fugees of Flanders for the cultivation and great commerce of this root.

It is known in trade and dying under the names of grape-madder, bunch-madder, &c. It is however the ſame root; all the difference in regard to its quality is, that the one kind contains pith and root, and the other has the ſmall fibres from its principal root adhering to it.

Both are prepared by the ſame work, which I ſhall not relate the particulars of here, as it would only ſerve to lengthen this treatiſe to no purpoſe.

They chooſe the fineſt roots for the firſt ſort, drying them with care, grinding them and ſeparating the rind at the mill, and preſerving the middle of the root ground in hogſheads, where it remains for two or three years; for after this time, it is better for dying than it would have been coming from the mill; for if madder was not kept cloſe after this manner, the air would ſpoil it, and the colour would be leſs bright. It is at firſt yellow, but it reddens and grows brown by age; the beſt is of a ſaffron colour, in hard lumps, of a ſtrong ſmell, and yet not diſagreeable. It is alſo cultivated about Liſle in Flanders, and ſeveral other places of the kingdom, where it was found to grow ſpontaneouſly.

The madders which are made uſe of in the Levant and in India, for the dying of cottons, are ſomewhat different from the kinds uſed in Europe, it is named *chat* on the coaſt of Coromandel. This plant thus called grows abundantly in the woods on the coaſt of Malabar, and this chat is the wild ſort. The cultivated comes from Vaſur and Tuccorin, and the moſt eſteemed of all is the chat of Perſia, named *dumas*.

They alſo gather on the coaſt of Coromondel the root of another plant called *ray de chaye*, or

root of colour, and which was thought to be a kind of *rubia tinctorum*, but is the root of a kind of *gallium flore albo*, as it appeared by obſervations ſent from India in 1748. It is a long ſlender root, which dyes cotton of a tolerable handſome red, when it has received all the preparations previous to the dye.

At Kurder, in the neighbourhood of Smyrna, and in the countries of Akiſſar and of Yordas, they cultivate another kind of madder, which is called in the country *chios-boya ekme bazalà*. This of all the madders is the beſt for the red dye, by the proofs that have been made of it, and far more eſteemed in the Levant than the fineſt Zealand madder the Dutch bring there. This madder ſo much valued is called by the modern Greeks *lizari*, and by the Arabs *foiioy* *.

There is another kind of madder in Canada called *tyſſa-voyana*. It is a very ſmall root, which produces pretty near the ſame effect as our European madder.

The water of preparation for madder red is pretty near the ſame as for kermes, that is compoſed of allum and tartar. The Dyers do not agree as to the proportions; but the beſt appears to be four ounces of allum and one of red tartar to each pound of ſpun wool, and about one-twelfth part of ſour water, and let the wool boil in it for two hours. If it is ſpun wool, leave it for ſeven or eight days, that it may be well moiſtened by the diſſolution of theſe ſalts; and if it is cloth, finiſh it the fourth day.

To dye wool with madder, prepare a freſh liquor, and when the water is come to a heat to bear the

* Theſe kinds of madders give brighter reds than the beſt grape madder of Zealand, for they are dried in the air and not in a ſtove. The madder of Languedoc, even that of Poitou, ſucceeds as well as that of lizari, when it is dried without fire.

the hand, put in half a pound of the fineſt grape madder for each pound of wool; let it be well raked and mixed in the copper before the wool goes in, keep the wool in an hour, during which time it muſt not boil *. Shades from madder are obtained after the manner laid down for other colours, but theſe ſhades are little uſed, except in a mixture of ſeveral colours.

When ſeveral pieces of cloth are to be dyed at once in madder red, the operation is the ſame, only augmenting the ingredients in proportion; and let it be remarked that in ſmall operations the quantity of ingredients muſt be ſomewhat greater than in great, not only in madder red, but in all other colours.

Theſe reds are never ſo beautiful as thoſe of the kermes, and much leſs ſo than thoſe of the lacque or cochineal, but they coſt leſs, and are made uſe of for common ſtuffs whoſe low prices would not allow a dearer dye. Moſt of the reds for the army are of madder, ſaddened with archil or brazil (though theſe drugs be of the falſe dye) to make them finer, and more on the velvet, which perfection could not be procured to them even with cochineal, without conſiderably augmenting the price.

I have already ſaid that madder put on ſtuffs not being prepared to receive it by the allum and tartar-water, did in fact give its red colour, but that which it dyed was blotted and not laſting, it is therefore the ſalts that ſecure the dye; this is common to all other colours red or yellow, which cannot be made without a preparing liquor. Now the queſtion is, whether theſe act by taking off the remains of the oily and fat tranſpiration of the ſheep, or

* If madder is boiled its red becomes obſcure, and of a brick [illegible]

or whether that of the two ſalts, particularly that which even cannot be carried by luke-warm water, remains to catch, ſeize and cement the colouring atom opened or dilated by the heat of water to receive it, and contracted by the cold to retain it.

To determine which, uſe any alkaline ſalts, ſuch as pot-aſh, the clarified lays of oak-aſhes, or any other pure lixivial ſalt inſtead of allum and tartar, put in a due proportion ſo as not to diſſolve the wool, and afterwards dip the ſtuff in madder liquor. This ſtuff will come out coloured, but will not laſt, even boiling water will carry off three-fourths of the colour. Now it cannot be ſaid that a fixed alkaline ſalt is unfit to extract from the pores of the wool the yolk or fat of the ſheep, ſince lixivial ſalts are uſed with ſucceſs in ſeveral caſes, to take the greaſe out of ſtuffs of what kind ſoever they be, which water alone could not take off. It is alſo well known, that with fats foreign to the ſtuff, and an alkaline ſalt, a kind of ſoap is formed which water eaſily carries off.

Again, take a piece of ſtuff dyed in madder red, according to the uſual method, boil it ſome time in a ſolution of fixt alkaline ſalts, a ſmall quantity will alſo deſtroy the colour, for the fixt alkali, attacking the ſmall atoms of the cryſtal of tartar or crude tartar, which lines the pores of the wool, forms a ſoluble tartar, which water diſſolves very eaſily, and conſequently the pores being opened in the hot water of the experiment, the colouring atom came out with the ſaline atom that ſheathed it.

This ſtuff being waſhed in water, the remaining red colour is diluted, and a colour half brown and half dirty remains. If, inſtead of an alkaline ſalt, ſoap is ſubſtituted (which is an alkaline ſalt, mitigated by oil) and another piece of cloth dyed alſo in madder, be boiled for a few minutes, the red

red will become finer, becauſe the alkali which is in the ſoap being ſheathed with oil, it could not attack the vegetable acid, and the boiling only carried off the colouring parts ill ſtuck together, and their numbers diminiſhing, what remains muſt appear deeper or clearer.

I muſt alſo add, for further proof of the actual exiſtence of ſalts in the pores of a ſtuff prepared with allum and tartar, before dying it with madder, that more or leſs tartar gives an infinite variety of ſhades with this root only; for if the quantity of allum be diminiſhed, and that of the tartar augmented, a cinnamon will be had, and even if nothing but tartar alone be put into the liquor, the red is loſt, and a deep cinnamon or a brown-root colour is obtained, though of a very good dye; for the crude tartar, which is an acid ſalt, has ſo much diſſolved the part which ſhould have produced the red colour, that there only remained a very ſmall quantity, with the ligneous fibres of the root, which, like all other common roots, does then yield but a brown colour, more or leſs deep according to the quantity uſed. I have already proved that the acid which brightens the red, diſſolves them if too much is uſed, and divides them into particles ſo extremely minute that they are not perceptible.

If in the place of tartar, any ſalt which is eaſily diſſolved be put with the allum in the liquor, to prepare the ſtuff for the madder dye, ſuch as ſalt petre, the greater part of madder red becomes uſeleſs, it diſappears, or does not ſtick on, and nothing is got but a very bright cinnamon, which will not ſufficiently ſtand the proof, becauſe the two ſalts uſed in the preparing liquor are not of the hardneſs of the tartar.

Volatile

Volatile urinous alkalis which are obtained from certain plants, ſuch as the perilla, the archil of the Canaries, and other moſſes or lichens, deſtroy alſo the madder red, but at the ſame time communicate another to it, for on experiment, madder prepared after the manner of archil with fermented urine and quick lime, produced only nut colours, but which nevertheleſs are laſting; becauſe there entered into the liquor only the little portion of urinous volatile that moiſtened the madder which the boiling was ſufficient to evaporate, and beſides, the cloth was ſufficiently furniſhed with the ſalts of the liquor made as uſual, to retain the colouring parts of the dye.

When a pure red, that for cochineal an example, is laid upon a cloth firſt dyed in blue, and afterwards prepared with the liquor of tartar, and allum to receive and retain this red, a purple or violet is produced according to the quantity of blue or red. The red of madder has not this effect, for it is not a pure red like that of the cochineal, and as I ſaid above, it is altered by the brown ligneous fibres of its root, and makes on the blue a cheſnut colour, more or leſs deep according to the preceding intenſity of the blue firſt laid on. If this cheſnut colour is wanted to have a purple caſt, a little cochineal muſt be added.

In order to avoid this brown of the root, the Dyers who make the beſt reds of madder take great heed to uſe the liquor of madder a little more than luke-warm; the madder tarniſhes conſiderably by the heat of the water, extracting the particles which dye brown, and unite themſelves with the red.

This inconveniency might be remedied, if at the time that the madder root is freſh a means could be found to ſeparate from the reſt of this root the red circle which is underneath its brown pellicle, and

and which ſurrounds the middle pith; but this work would augment its price, and even then it would not afford ſo good a red as cochineal. However, it might be attempted to dye cottons red, whoſe price might bear the expences of this preparation.

Madder being of all ingredients the cheapeſt of any that dye red and of the good dye, it is mixt with others to diminiſh the price. It is with madder and kermes that the baſtard ſcarlets of grain are dyed, otherwiſe called half-grain ſcarlets, and with madder and cochineal the half-common ſcarlets, and the half-crimſons are made.

To make the half-grain ſcarlet, the water of preparation, and all the reſt of the operation is to be performed after the ſame manner as ſcarlet made of the grain of kermes, or the common Venetian, only the ſecond liquor is compoſed of half kermes and half grape madder.

For the half-ſcarlet and flame colour, the compoſition and preparation is as uſual, nothing but pure cochineal being put in, but in the reddening, half cochineal and half madder is uſed: here alſo the ſylveſtre may be made uſe of, for after having made the preparation with cochineal for reddening, uſe half a pound of cochineal, a pound and a half of ſylveſtre, and one pound of madder inſtead of cochineal alone.

That the wool and ſtuffs may be dyed as equally as poſſible, it is neceſſary that the two kinds of cochineal be well rubbed or ſifted, as alſo the madder, with which they muſt be well incorporated before they are put into the liquor. This muſt be obſerved in all colours where ſeveral ingredients are mixt together. This half ſcarlet is finiſhed like the common ſcarlet, and it may be ſaddened after the

the ſame manner, either with boiling water or allum.

The half-crimſon is made like the common crimſon, only uſing half madder and half cochineal, the cochineal ſylveſtre may be uſed here alſo, obſerving only to retrench half of the common cochineal, and to replace it with three times as much of the ſylveſtre. If a greater quantity of the ſylveſtre was uſed, and more of the other taken off, the colour would not be ſo fine. Various ſhades may be produced by augmenting or leſſening the madder or cochineal.

Purple with Madder without Blue.

I ſhall finiſh this chapter with an experiment which afforded a pretty fine purple without cochineal, or without the cloth being firſt dyed blue. I boiled a piece of cloth weighing half an ounce, with ten grains of Roman allum, and ſix grains of cryſtal of tartar; half an hour after, I took it out, wrung it, and let it cool; then added to the ſame liquor twenty-four grains of grape madder; after it had furniſhed its dye to this liquor, ſtill impregnated with ſalts, I dropt in twenty-four drops of a ſolution of biſmuth, made with equal parts of water and ſpirit of nitre, and then dipt my cloth again. Half an hour after, I took it out, wrung and waſhed it; it was almoſt as fine a crimſon as if it had been done with cochineal, it had even a ſufficient ground to have remained in that ſtate.

I dipt it again in the ſame liquor, and boiled it for a quarter of an hour; it came out a pretty bright purple; this purple, tried by the proof of allum, rouzes and embelliſhes itſelf, and by the proof of ſoap it remained of a much finer red than the common reds of madder.

If

If the cloth be kept for ſeveral days moiſtened in its liquor of tartar and allum, and afterwards dyed in freſh madder liquor, plain and without ſalts, according to the common method, till it has taken a bright cinnamon colour, and to this liquor be added the ſame ſolution of biſmuth, a cheſnut colour, and no purple will be obtained. This ſhews what exactneſs is required in deſcribing the proceſſes of dying, for want of which, all books hitherto publiſhed on this art have been uſeleſs, as they neglected to point out the neceſſary circumſtances for the ſucceſs of the deſired colour.

In this ſecond experiment, the cloth did at firſt take too much ſalts, they remained too long in it, and there was none in the liquor of the dye; for want of allum the purple did not appear, becauſe the white earth of this ſalt could not precipitate itſelf with the diſſolved parts of the biſmuth, which, as has been ſaid in the chapter of the kermes, carry with them the blue parts of the ſmalt, which is always found in the mine of biſmuth, and a portion of which very probably unites itſelf to this half metal during the melting. This mutual precipitation is performed in operation of dying, by the help of the aſtringent parts of the ligneous fibres of the madder root.

CHAP. XV.

Of YELLOW.

HItherto ten ſorts of drugs have been named for dying yellow, but by the proofs that have been made it is certain there are but five that are ſufficiently laſting to be uſed in the good dye. Several more might be added to theſe five, as yellows

lows are easily obtained. I shall therefore first speak of these five, which are the weld or wold, savory, green wood, the yellow wood and the fenugreek, because these only are of the good dye. The three first are very common plants in Europe, the yellow wood comes from the Indies, and fenugreek is found every where. Weld is most commonly used, as it gives the brightest dye. The savory and the green wood are best for wools that are to be made greens, because their natural colour borders a little on the green; the two others give shades of yellow somewhat different.

The yellows most known in the art of dying are the straw yellow, the pale yellow, and the lemon yellow. The orange yellows commonly made are not simple colours, therefore I shall not speak of them here.

For dying yellow, the common preparing water with tartar and allum is used for wool or stuffs, in the proportion of four ounces of allum for each pound of wool, or twenty-five pounds for the hundred, and one ounce of tartar, and the method of boiling is the same as before. For welding, after the wool or stuff is boiled, put five or six pounds of weld in a fresh liquor for each pound of stuff; let the weld be inclosed in a linen bag, that it may not mix with the stuff, and that the bag may not rise to the top of the copper, it must be kept down with a heavy cross of wood. Others boil the weld till it has furnished all its dye, and sinks itself to the bottom of the copper, at which time they place on it a cross or iron circle fitted with a net of cords. Others take it out with a rake when it is sufficiently boiled: sometimes yellow wood and other ingredients are mixed with the weld, according to the shade required, by altering the quantities and the proportions of the salts

in

in the preparation, and the time of boiling. I know by experience, that these shades may be obtained *ad infinitum*. This proof I have had in the essays I made with the flower of the virga, a very great acquisition in the art of dying, if this plant was improved, which may be easily done, since it shoots a great many stems, and whose small ones may be easily transplanted, and produce quantities in the course of one year.

Light shades of yellow are obtained in the same manner as all others spoken of, only the preparing liquor for these light yellows must be weaker. I recommend twelve pounds and a half of allum for each hundred pounds of wool, and the tartar in proportion; but these light shades do not resist the proofs as deeper shades do, made with the full proportion of tartar.

Some Dyers endeavouring to help this, leave the wool and stuffs for a longer time in the dye, because they take it slower in proportion to the weakness of the liquor; but if they put at the same time in the colouring liquor, wools whose preparation shall have been different, they shall take at the same time different shades. These liquors more or less strong are called half-preparing liquors, or quarter-preparing liquors, and they make great use of them in light shades of wool dyed in the fleece, that is, before being spun, and which are intended for the manufacturing of cloths and other mixed stuffs; because the more allum there is in the liquor of the wool, the more it is harsh and difficult to spin, and it must spin thicker, and consequently the stuff is coarser. This observation is not of great consequence for spun wool which is intended for tapestry or for stuffs. I only mention it to shew that the quantity of ingredients may be sometimes varied without danger.

The yellow wood is uſed in chips, or in coarſe ſhavings; by this means it is more divided, and yields its dye the better, and a leſs quantity will do; which way ſoever it is uſed, it is put into a bag, that it may not mix with the wool or ſtuffs. The ſame precaution is neceſſary for the ſavory and green wood, when they are mixed with the weld to change its ſhade.

I refer to the leſſer dye the five other ingredients hitherto known which dye yellow, and ſhall only obſerve here in regard to the good dye, that the root of the dock, the bark of the aſh-tree, particularly that which is raiſed after the firſt ſap, the leaves of almond, peach and pear-trees; in ſhort, all leaves, barks, and roots, which by chewing ſhew ſome little aſtriction, give yellows of the good dye more or leſs fine, according to the time they are boiled, and in proportion to the tartar and allum uſed in the liquor: a proper quantity of allum brings theſe yellows to the beautiful yellow of the weld. If the tartar is in greater quantity, theſe yellows will border on the orange; and laſtly, if theſe ingredients are too much boiled, let them be roots, barks, or leaves, the yellow obſcures itſelf, and takes brown ſhades.

Altho' ſome Dyers uſe turmerac in the good dye, which gives an orange yellow, this practice is to be condemned, for it is a colour that ſoon paſſes in the air, unleſs it be ſecured by ſea-ſalt, which ſome Dyers do, who take care to keep this impoſition to themſelves. Thoſe who make uſe of it in common ſcarlets, to ſpare cochineal, and to give to their ſtuff a red bordering on the orange, are blameable, for the ſcarlets that have been dyed after this manner loſe in a ſhort time that bright orange, as I have already ſaid, they brown conſiderably in the air. Yet theſe falſifications are obliged

obliged to be in ſome meaſure tolerated; for at this time that bright orange being in faſhion, it would be impoſſible to give it to ſcarlet, without putting a larger doſe of compoſition, whoſe acids would greatly hurt the cloth. The fuſtic wood is now preferred in ſcarlet.

CHAP. XVI.

Of BROWN.

BROWN is the fourth of the primary colours. It is placed in this rank, becauſe it enters in the compoſition of a great number of colours. The working it is different from others, for commonly no preparation is given to wool to be dyed brown, and, like the blue, it is only dipped in hot water.

The rinds and roots of walnut, the rind of the alder, ſantal, ſumach, roudoul or ſovic, ſoot, &c. are uſed in this dye.

The rind of the walnut is the green part that covers the nut; they are gathered when the nuts are entirely ripe, then filled into great caſks and moiſtened with water; they are thus preſerved until the enſuing year, and longer if required.

The ſantal or ſaunders is a hard wood brought from the Indies; it is commonly uſed ground to a very fine powder, it is preſerved for ſome time in this ſtate in bags, to excite (as imagined) a ſlight fermentation, which they pretend makes it the better for uſe, but I could find no difference.

This wood is moſt commonly ground with a third part of cariatour wood, which ſoftens it according to thoſe who ſell it. It is greatly inferior to walnut rinds, for it hurts the wool by hardening

it confiderably if ufed in large quantities, therefore it is better not to ufe it for fine wools and ftuffs, or at leaft to draw but the lighteft fhades, for then its effect will be of lefs confequence. It is generally mixed with galls, alder, bark, and fumach; it is only by this means that it gives its colour when ufed alone, and unmixed with the cariatour wood. It yields but very little with the liquor of allum and tartar unlefs it be rafped. Notwithftanding this defect, it is tolerated in the good dye, on account of the folidity of its colour, which naturally is a yellow-red-brown: it browns and grows deep in the air, it lightens with foap, but lofes lefs by the the proof of allum, and ftill lefs by that of tartar.

Of all the ingredients ufed for the brown dye, the walnut rind is the beft; its fhades are finer, its colour is lafting, it foftens the wool, renders it of a better quality, and eafier to work. To make ufe of this rind, a copper is half filled, and when it begins to grow luke-warm, the rind is added in proportion to the quantities of ftuffs to be dyed and the colour intended. The copper is then made to boil, and when it has boiled a quarter of an hour, the ftuffs, which were before dipped in warm water, are put in. They are to be ftirred and turned until they acquire the defired colour. If it is fpun wool, and that the fhades required are to be matched with great exactnefs, a fmall quantity of rind is to be put in firft, and the lighteft are firft made; more rind is then put in, and then the deepeft are made: but to work with ftuffs, the deepeft are generally made firft, and as the colour of the liquor diminifhes, the lighteft are dipped; they are aired as ufual to cool them, dried, and dreffed.

Next to the walnut rind is the root; it gives a great number of fhades and pretty near the fame; thus they may be fubftituted the one for the other, according

according to the facility of obtaining them, but there is a difference in the manner of using the root. A copper is filled three quarters full of river water; the quantity of root that is thought convenient is cut into small pieces, and added in proportion to the quantity of wool to be dyed and the shade required.

When the liquor is hot so as not to bear the hand, the stuffs are put in and turned, until they have the desired shade, carefully observing to air them from time to time, and to pass them between the hands by the lists, to make the small pieces of roots that stick fall off to prevent their blotting; but this may be remedied by inclosing the cut root in a bag, as has been said of the yellow root. The stuffs that are to be of lighter shades are then to be dipped, and to be thus continued until the root gives no more dye. If it is spun wool, the lightest are to be made first to match them the better, as I have already said in speaking of other colours; but above all, care must be taken not to boil the liquor at first, for then this root would give all its colour to the first piece of stuff, and there would not remain sufficient for the rest.

The method of dying wool with roots is not very easy, for if great care is not taken to bring the dye to a proper degree of heat, and to stir the wool and stuffs so that they may be equally soaked in the copper, they run the hazard of being made too deep or of being blotted, which cannot be remedied but by giving them a chesnut, prune, or coffee colour, as I shall shew when I treat of the colours and shades arising from the mixture of black and brown.

To avoid this inconvenience, the stuffs must be continually turned round the wynch, and dipped piece after piece, and great care must be taken not to boil the roots too much, but always to leave

ſome dying ſubſtance in them. When the wool or ſtuffs are dyed after this method, they are aired, waſhed, and dried.

The method of treating the alder bark differs not from that of the walnut root before deſcribed, except that there is leſs danger in boiling it at the beginning, as it gives leſs ground of colour to the ſtuff. It is commonly uſed for thread, and for colours that are to be ſaddened with green copperas; it has however a good effect on wool for colours that are not very deep, and it perfectly reſiſts the action of the air and ſun.

The ſumach is pretty near the ſame; it is uſed after the ſame manner as the green ſhells or inward coats of walnuts; it ſtill gives leſs ground of colour, and borders ſomewhat on the green; it is often ſubſtituted for galls in colours that are to be ſaddened, and it anſwers perfectly well, but muſt be uſed in larger quantities.

Theſe different matters are often mixed together, and as they are equally good, and produce nearly the ſame effect, they readily afford a variety of ſhades; and yet there is nothing but practice can teach this variety of brown ſhades, for they entirely depend on the eye of the Dyer.

To uſe theſe ingredients mixt, and ground ſaunders together, put four pounds of this laſt into a copper, half a pound of powdered galls, twelve pounds of elder bark, and ten pounds of ſumach; this quantity will dye twenty-five or twenty-ſeven ells of cloth; the whole is boiled, and having ſlackened the boil by means of a little cold water, the cloth is put in, turned, and well ſtirred for two hours; after which it is taken out, aired and waſhed; other ſtuffs that are to be of a lighter ſhade are then put in, and thus continued as long as the liquor affords any colour.

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The quantity of these ingredients is augmented or diminished in proportion to the height of the shade, and the stuffs or wool are boiled more or less accordingly. I have already observed that by this means only the colour can be extracted from the saunders.

I have here treated of the saunders and the manner of using it, although it should have been classed with the lesser dyes, as this woad ought only to be used for stuffs of low prices, because of the defects before spoken of; yet as it is worked almost after the same manner as the other ingredients for dying brown, and in several places is even tolerated in the good dye, as it resists the sun and air as well as the others, I thought it would not be improper here to give the method of working it; for the same reason I shall now describe the method of dying with soot, though permitted only in the lesser dye, having less solidity than the rest, besides hardening the wool, and giving a disagreeable smell to the stuffs.

The soot* is commonly put into the copper the same time as the water, and the whole is well boiled together; the stuff is then dipt in, which is to boil more or less according to the shade required; after which it is taken out and aired, and those put in which are to be lighter; they are then to be well washed and dried, but it is better to boil the soot in the water for two hours than let it settle, and empty the liquor into another copper, without mixing the soot; the wool and stuffs are put into this liquor, and are less hardened and dryed than when they have been mixt with the soot itself, but the colour is not solid, and it is better not to make use of it for dying stuffs that bear a price, and more

* Wood soot.

more ſo as all its ſhades may be had by the foregoing ingredients, which are better, more laſting, and alſo ſoften the wool.

The Dyers of the leſſer dye uſually employ the rinds of the nut and the root of the walnut-tree for their brown colours; the working of theſe two ingredients being common to Dyers of the greater and leſſer dye; but there are places where it is difficult to obtain them, and then the saunders and even ſoot are obliged to be uſed in their ſtead.

What I have hitherto ſaid to account for the ſolidity of the colours of the good dye, may ſeem not to agree with brown colours ſpoken of in this chapter, ſince theſe are firmly applied on the wool without any preparation to receive them by the liquor of allum and tartar, and conſequently without firſt introducing into the pores of the fibres a ſalt capable of hardening itſelf in the cold, and to cement the atoms that colour the brown; but if on a chymical analyſis the green ſhell of walnuts, the root of the walnut-tree, the rind of alder, ſhould be proved to contain, beſides their aſtringent properties, a vitriolated tartar, which is a ſalt that does not calcine in the ſun, and that is only diſſolved by boiling water; this I ſay will convince that theſe ingredients are ſufficient of themſelves to produce on the ſtuffs, without any foreign help, the ſame effect as the other drugs, whoſe colours are not ſet in with ſolidity, but by the help of a ſalt capable of cementing the colouring atoms.

The ſoot does not give ſo laſting a brown, becauſe it only contains a volatile and an earthy ſalt eaſily diſſolved, and in fact the ſoot being only compoſed of the lighteſt and moſt volatile parts of combuſtible bodies, which have ſerved as food for the fire, it could not raiſe tartar of vitriol along

with

with it, which is a ſalt that does not riſe by heat, and which is alſo ſeldom found in the wood which we commonly burn in our chimnies.

As I am not willing to omit any thing within the limits of my knowledge, on the article of woollen dying, I ſhall give two or three hints on the acid of vitriol.

If you would have a beautiful claret on wool, ſtuffs, or cloth, boil in a copper of a good ſize, redwood or ſaunders in proportion to the ſhade you want, and two pounds of logwood, for forty pounds of wool previouſly ſcoured. When the ingredients have boiled half an hour, put a pint of oil of vitriol into a pail of cold water, and add it to the liquor, when the wool muſt be put in, and gently boiled for two or three hours. It is then to be taken up on a ſcray, that is, ſet acroſs the copper to drain, and five or ſix pails of water poured over it. The copper muſt be then run down and filled as before with fair water, and when it is hot, ten pounds of copperas and four ounces of pearl-aſhes muſt be added, and the wool returned and well worked with a long pole to make it even.

The aſhes (which are a fixed alkali) act upon the logwood, and give it a fine luſtre at the ſame time. It weakens the acid of the vitriol, and makes way for the copperas to do its part, which would otherwiſe be kept at a diſtance; the vitriol does not obſtruct the cloth in the fulling-mill, for the vitriol, which ſome ſuppoſe to be a great enemy in the mill, is diveſted of its acid by the ſtrong alkali contained in the chamberley in ſcouring, and the colour remains perfectly vivid. If for forty pounds of wool, &c. ten pounds of nut-galls were bruiſed and boiled with the above ingredients, the acid therein contained would produce as brilliant a colour, and, if poſſible, more holding than the former;

former; but if galls are uſed, the ſame liquor will do the ſame buſineſs when the copperas is added without aſhes as a freſh water would when vitriol is uſed. If forty pounds of cloth, ſtuff, or worſted were boiled in a ſufficient quantity of redwood or ſaunders, and one pint of prepared aqua-fortis be added to the liquor after the goods have boiled an hour and a half, and then turned well for half an hour, the colour will be vivid and fine; the copper muſt be well cooled when the ſpirits are put in.

When cloth or ſtuffs are dyed claret with oil of vitriol, great care muſt be taken to turn them continually over the wynch, and particularly in taking out obſerve the inſtant the laſt end comes up to take off into a large tub of cold water, that all parts may cool alike, or the colour will be very uneven, as the vitriol when hot will not bear the air.

Oil of vitriol is ſo uſeful a thing in dying, that any colour, ſave woaded blue or green, may, by the help of its acid, be brought to a fine claret, black not excepted.

CHAP. XVII.

Of BLACK.

BLACK is the fifth of the primary colours. To dye the beſt and moſt lively ſhade, a veſſel ſufficiently large muſt be filled with ſoft water, and for every hundred weight of cloth, thirty pounds of logwood in chips muſt be put in, with half a pail of elder bark and ſix pounds of ſumach; boil theſe ingredients together half an hour, when the cloth may be entered (the copper being firſt cooled by the

the addition of cold water) and boiled an hour and a half, being inſtantly turned on the wynch to prevent an unevenneſs of dye. This operation being ended, which is called a preparation or ſtuffing the blacks, I ſhall proceed to the finiſhing.

A ſmall tub is to be placed at the ſide of the copper, out of which it muſt be filled with hot liquor, in which put ten or fourteen pounds of copperas to diſſolve; the cloth is then kept turning, whilſt a man with a piggin is lading the copperas water into the copper; the cloth is turned here at a boiling heat one hour, then taken out and cooled well in all parts alike; when thoroughly cold, return it into the copper, with two handfuls of copperas, and boil it gently as before for two hours, then cool it again.

Whilſt the ſecond cooling is carrying on, ſix pounds of logwood, ten pounds of bark, and two pounds of argil, with ten pounds of ſoda or common aſhes, and three pounds of copperas, muſt be added to the liquor; theſe ingredients muſt be made to boil one hour, when the goods muſt be turned and worked one hour. Keep the wynch continually turning, always obſerving that the ſmall portion of air which the goods receive by turning on the wynch, contributes much to the beauty of the colour. Some Dyers inſtead of aſhes uſe chamberley, but this is a bad cuſtom. If they would become good black Dyers, they muſt abandon their old practice, and by mixing their natural genius with reaſon and good ſenſe, they will ſoon find by experience, that the acid of the argil acts only on the vitriolic acid of the copperas, and prevents a brown or ruſty hue that will unavoidably proceed from the logwood; the alkaline power of the aſhes at the ſame time forces it to aſſume its natural violet colour; that if too great a quantity of logwood is not

uſed,

ufed, (which would certainly prejudice the colour) and this rule carefully obferved, the black would refemble a raven's feather; they muft be well wafhed at the fulling-mill.

I fhall not entertain the reader with a tedious recital of the manner of treating thofe goods whofe fuperior quality renders it needful that they fhould previoufly be dyed blue. It is fufficient to know, that they muft have a lefs proportion of ingredients, though the operation is the fame as that of the common black.

When fine cloth is to be dyed black, great care muft be taken not to let it hang on the wynch one minute; it muft be thrown off that inftant the laft comes up; otherwife its own weight when wet and hot would fill it with wrinkles that would never remove. The fame caution muft be taken when the cloth is on the floor, to draw it between two men over a long ftick by the lifts, each taking hold of one end with their left hand, to be continued till cold before it be returned.

Remarks on the Black Dye.

The moft effential thing to be remarked, is, that it prejudices and weakens the goods; for this reafon thofe that are dyed black are fooneft worn out; they are however in all other refpects equal to thofe that are dyed other colours. This defect is chiefly to be attributed to the vitriolic acid of the copperas, which is only imperfectly faturated by the iron; as iron united to any other acid, and even to vegetable acids, is capable of producing black with aftringent vegetables. There is great caufe to think that by fubftituting other combinations of this metal for the copperas, this inconvenience might be remedied.

These

These are certainly good and useful essays to attempt. It is not without cause that the blacks are directed to be aired between the dippings, as it infinitely contributes to the beauty of the dye; for it is certain that this dye is different from most others which lose of their colour in drying; this, on the contrary acquires a great deal; it is universally known, that good writing-ink does not appear any thing near so black when fresh and recently used, as when dry, and that even it grows more black during a certain space of time. The same happens to the black dye. The cloth is in some measure of a grey-blackish colour immediately after the first dip; it only acquires the beautiful black on being exposed to the air; this is not the only example of the influence of the air on colours; the blue-vat exhibits something like it.

C H A P. XVIII.

Of the MIXTURE *of* BLUE *and* RED.

IN speaking of the red I observed that there were four different kinds in the good dye. We shall now explain the effect of these different reds placed on a stuff that has been previously dyed blue. If a blue stuff is boiled in allum and tartar (after the manner and proportion taught in the article of red, and which is afterwards to be dyed with kermes) the following colours will result, viz. The king's colour, the prince's colour, the pansy, the violet, the purple, and several other like colours; but the kermes is seldom used for these colours, on account of its high price, and the quantity which would be required, but more so,

becauſe cochineal yields a finer colour for this purpoſe, and with greater eaſe. I have already obſerved that kermes is ſeldom uſed, though there are ſeveral compound colours in which it produces a very good effect, as will be more particularly deſcribed.

When the kermes is uſed to lay a red on blue, it is indifferent what ground of blue is firſt given, or whether it be given before or after the ſtuff is dyed red, becauſe the colour of the kermes is too ſolid to be changed by the lime of the woad vat, (unleſs the vat be overloaded) or by the pearl-aſhes in the indigo. Thus if the woad vat is not too old, it may be begun by either of theſe two colours at pleaſure, or by that which is moſt convenient to match the ſhade. Although I named but a ſmall number of colours, a great many may be drawn from theſe two principal ones, according as the one or the other may be more predominant.

The mixture of blue with fire-colour ſcarlet is never uſed in any of their ſhades. To convince myſelf by experience, I took a piece of cloth dyed in ſcarlet, and dipt it in the blue vat, and I dyed a ſecond piece according to the method of dying ſcarlet, having previouſly dyed it blue. The one and the other ſucceeded very badly, and made a kind of dull ſpotted violet, ſo it appeared that the two colours did not unite, but that they were laid each on different parts of the wool. This no doubt is cauſed by the acids which enter the compoſition of the ſcarlet. But without entering here upon the phyſical reaſon of this operation, which might occaſion too long a diſſertation, and tedious repetition of what I have already ſaid, the fact appears ſufficient here: it proves that no beautiful colour can

can be had from the mixture of blue and ſcarlet; it muſt be crimſon.

From the mixture of blue and crimſon, the columbine, the purple, the amaranth, the panſy, and the violet are formed; theſe colours have alſo a great number of ſhades which depend upon the ſhades of the other colour, from whence they are derived.

I have ſaid ſo much on the primary colours, that no difficulty can remain in the execution of the compound colours.

Stuffs or ſpun wool are firſt made of one colour, and then dyed of the other, preciſely as if it was white; but it muſt be obſerved in this caſe, that the ſtuff be firſt dyed blue before it is made into crimſon, for the reaſon before given, that the alkali of the one or other vat greatly obſcures the brightneſs of the red of the cochineal.

To make violets, purples, and other like ſhades, what I have already ſaid on crimſon is to be followed, becauſe theſe colours will have neither brightneſs nor luſtre, but by following the precautions neceſſary for making fine crimſons.

From blue, and the red of madder, proceeds alſo the king's colour, the prince's colour, (but infinitely leſs beautiful than when the kermes is made uſe of; for the red of the madder is always obſcured by the brown of its ligneous parts) the minime, the tan colour, the amaranth, the dry roſe, always leſs bright than when the kermes is made uſe of. Nevertheleſs, it is ſometimes mixed with madder, as I have already ſaid, to make half-grained ſcarlets, and the colours which proceed from it are always finer than when madder alone is uſed on a ſtuff dyed blue; madder is alſo mixed with cochineal, as in the half crimſons, and a great number of very fine ſhades are drawn from them,

which cannot have particular names, but which border on those I have just mentioned. Some of these may be made as fine as if dearer ingredients were made use of. It is the business and profit of the Dyer not to use the dearest, when the same effects may be produced by the cheapest ingredients. It is impossible for me to give any instructions on this article, since use alone can teach it. The old liquor of madder and cochineal is often used, whose colours have not been entirely extracted, which makes a considerable saving, and the colour is not less good. I can say nothing positive on this, since the effect which will result from it depends on what colour may remain in the liquor, and on the shade intended.

C H A P. XIX.

Of the MIXTURE *of* BLUE *and* YELLOW.

FROM the mixture of blue and yellow but one colour is produced, which is green; but there are a variety of shades; the principal ones are, the yellow green, the light green, the gay green, the grass green, the laurel green, the molequin green, the deep green, the sea green, the celadon green, the parrot green, the cabbage green, and I shall add, the duck-wing green, and the celadon green without blue. All these shades, and the intermediate ones, are made after the same manner and with the same ease. The stuff or wool dyed blue, light or dark, is boiled in allum and tartar, as is usually done to make a white stuff yellow, and then with weld, savory, or greening wood. All these ingredients are equally good as

to ſolidity, but as their yellows differ a little, ſo do the greens that ariſe from their mixture. The weld and the ſavory are the two plants that afford the fineſt greens.

To make the green ſhades which border on the yellow, the ſtuff muſt be of a very light blue, and boiled with the common quantity of tartar and allum, to receive the yellow; for without theſe ſalts it would not be laſting, (but for a parrot or cabbage green the blue muſt be very deep) and as it is only to have a light yellow, the ſtuffs muſt have but a half preparation; I have already mentioned this; ſometimes even a quarter of the water for the common preparation is ſufficient.

When the workmen make theſe colours, they often uſe the ſalts without weighing them, and gueſs at the quantity which they think neceſſary for the ſhade intended; a long practice may in ſome meaſure make them pretty exact, but it would be ſtill better if they did not truſt to it.

I know by repeated experiments that theſe green-blue ſhades are as well made by giving the ſtuff the common preparation. The yellow which is afterwards applied to it is the more laſting, but on this occaſion leſs weld is to be put into the liquor of the dye, or any other colouring matter, and the ſtuff muſt remain leſs time in the liquor, notwithſtanding two reaſons induced the contrary; the firſt and moſt intereſting to the Dyer is, that they would conſume a greater quantity of drugs than is neceſſary; and the ſecond, that the leſs allum uſed in the preparation, the more the ſoftneſs and the quality of the wool is preſerved, and the leſs the firſt dye of blue is damaged; for the allum always greys the blues a little. Thus it is better to leave the Dyer to his cuſtom of regulating the ſtrength of

 his

his preparation to the neceſſary pitch to give theſe colours.

I have ſaid that to dye green it was neceſſary that the wool ſhould be previouſly blue; becauſe I think that the two colours laid on in this order hold better, and that the colour would not be ſo good if otherwiſe done. Of this I aſſure myſelf by making the greens, of which I have ſpoken, with the five colouring matters already known, which make a yellow of the good dye; I have tried a yellow of the ſame materials, the contrary, having dipped five yellow pieces in the woad vat, and have had as fine greens as the firſt. I expoſed both to the ſummer's ſun, and they have reſiſted ſufficiently to be eſteemed of the good dye; but thoſe which had received the blue before the yellow loſt the leaſt, ſo that in particular circumſtances the Dyer muſt be allowed to begin firſt with yellow. But greens which have the blue colour laſt, will ſully the linen more than the others; for if the blue has been firſt dyed, all that could be taken off was done by the allum liquor, which happens on the contrary when the blue was put on laſt; the only remedy for this is, to ſcour the green well after it comes out of the copper.

Cloth dyed king's blue, and greened with the flower of the *virga aurea canadienſis*, makes a very fine green, provided it has been boiled in a liquor with three times the weight of allum to one of white tartar; the green is not inferior to that made of weld.

I have alſo greened blues with aſh-bark powdered; they are of a very good dye, but not of a fine colour, and only fit for liveries. The leaves of almond, peach and pear-trees, &c. give yellows, which ſerve to make green ſhades, that are rather difficult to hit on at firſt.

A ſtuff

A ſtuff dyed in the king's blue, well ſcoured, then boiled with four parts of allum and one of tartar, takes a fine deep green of the ſhade of a duck's wing; but it muſt be boiled for two hours in a liquor, with a ſufficient quantity of the root of ſharp-pointed dock groſsly bruiſed.

This root, which grows in every hedge and field, is a good acquiſition to the art of dying; for with it, and without any other addition but the preparing liquor for the ſtuffs, it produces an infinity of ſhades, from the ſtraw colour to a pretty fine olive; only putting more or leſs to the liquor, and boiling it from half an hour to three hours. Theſe ſhades ſtand all manner of proof. I ſtrongly recommend the cultivation of this dock in damp places, for its uſe in dying.

The celadon green (a particular colour) is much admired by the inhabitants of the Mediterranean, and may in ſtrict buſineſs be made in the good dye, by giving a blue ground to the ſtuff. But this ſhade of blue muſt be ſo weak that it is only a milk and water colour, which is very difficult to give ſmooth and equal. When this ſhade has been happily hit, it is eaſier to give the yellow dye that ſuits it, with the *virga aurea* than with the weld. The *virga aurea* is not known to the Dyers of Languedoc, who make moſt theſe kind of colours; and as the neceſſary blue ſhades are difficult to dye, they are ſometimes permitted to dye celadons with verdigriſe, although this colour be in the rank of the leſſer dye.

The Dutch make this colour perfectly, and render it more laſting than it commonly is with the verdigriſe. Here follows their method.

Two coppers are ſet a little diſtance the one from the other. In the firſt is put for two pieces of cloth of forty-five or fifty ells long, eight or ten

ten pounds of white ſoap cut ſmall and perfectly melted. When the liquor is ready to boil, the cloths are dipt in, and boil for half an hour. Another liquor is prepared in the next copper, and when it is ſcalding hot a cloth bag is put in containing eight or ten pounds of cyprus or blue vitriol, and ten or twelve pounds of lime, both powdered and well mixt; this mixture muſt be as equal as poſſible. The bag is moved about in the hot water, but not boiling, till all the blue vitriol is diſſolved in the liquor; then a wynch is put up, ſurrounded by a clean linen cloth, and well faſtened on; one end of the two cloths is put on the wynch, which is turned ſwiftly that the cloths may quickly paſs through the ſoap liquor to that of the vitriol; then the wynch is worked more gently, that the cloth may have time to charge itſelf with the parts of copper, which the lime has ſcattered in the liquor, by ſeparating and precipitating them from the vitriol which contained them. The cloths are left in this liquor, which muſt not boil until they have taken the ſhade of the celadon that was wanted; then they are taken out and well aired: they muſt be entirely cold before they are waſhed, and muſt touch no wood before they are, for the wood ſpots them; for this reaſon the wynch and the horſe are ſurrounded with cloth.

CHAP. XX.

Of the MIXTURE *of* BLUE *and* BROWN.

LITTLE uſe is made of the ſhade which ariſes from the mixture of blue and brown: theſe are greeniſh greys, or a kind of olives, which are only fit to match ſhades for tapeſtries; theſe colours

colours are eaſily made when wanted, and it is equal to begin by the blue or the brown colour to the ſpun wool; but care muſt be taken that it be well ſcoured, as is done for the blue and the compound colours which are finiſhed by dipping them in the vat. Any ſubſtance that dyes brown may be equally made uſe of for theſe colours, and ſome give the ſhade required better than others.

C H A P. XXI.

Of the MIXTURE *of* BLUE *and* BLACK.

NO particular ſhades ariſes from this mixture, except by the mixture of blue and grey (which are ſhades of the black). In this caſe the blue muſt not be very deep, and is afterwards worked the ſame as the black, excepting that the colour not being ſo dark leſs copperas enters in; but I repeat again that this colour ought only to be eſteemed a ſhade of the black. Thus it may be ſaid that no ſhades are made from blue and black uſed by themſelves, and very few from blue and brown.

C H A P. XXII.

Of the MIXTURE *of* RED *and* YELLOW.

FROM ſcarlet of grain or kermes and the yellow are formed the aurora, the marigold, and the orange. The wool is firſt boiled in allum and tartar, and dyed in one of theſe colours, and then dipped in the ſecond, or by mixing in the ſame li-

quor

quor the kermes, the weld, the savory, &c, and so dying it at once. Yet it is easier to attain the exact shades by dying it at twice; for this reason, the wool or the stuff may be alternately passed in the one or other liquor, till it be precisely of the desired colour.

The lobster and pomegranate colours are done exactly as scarlet is, that is, boiled with cream of tartar, cochineal, and the composition, after which they are taken out, aired, and washed. For the finishing, a fresh liquor is prepared as for the scarlet, but without cochineal; in its stead, a little yellow wood ground is substituted; this depends on the colour the stuff is intended to be of. The more it borders on the orange, the more yellow wood is added, diminishing the quantity of the cochineal.

I endeavoured to make this colour after three different methods, and succeeded in all; the first is that which I have described; the second is by putting fustic instead of yellow wood, and this saves a great deal of cochineal, and the shade of the fustic is a great deal more on the orange than the yellow wood, but these ingredients are not lasting, and ought not to be used but in the lesser dye. The method is with cochineal alone, by augmenting the quantity of the composition, which rouses the cochineal, and turns it to orange as much as is desired; but this is attended with very great inconvenience. 1st, The colour becomes very expensive, because it requires more cochineal than common scarlet, as the great quantity of the composition, which is an acid, makes it lose part of its ground. 2d, For the same reason the colour always looks starved, it apppears as if the cochineal had been spared, the composition having dissolved part of it. 3d, This large quantity of composition hardens

hardens the wool, and makes it more liable to be ſpotted by dirt and ſharp liquor, and conſequently this method is the worſt. I mentioned that the inconveniency of the ſecond was uſing the fuſtic, which is a wood forbid in the good dye; conſequently the firſt ought to have the preference, if it gave the lobſter colour as bright as the ſecond. But this colour made by the yellow wood has not all the ſolidity that might be deſired, as I have tried by expoſing it to the ſun; this at firſt appears extraordinary, ſince the ingredients uſed have all the ſolidity poſſible. But the reaſon why they are not ſo good in the preſent caſe is, that the cochineal uſed in the ſcarlet compoſition and the cream of tartar are too ſolid; thus the lobſter colour loſes nothing in the air. But the caſe is otherwiſe with the yellow wood though it be very laſting on the wool boiled in allum and tartar, eſpecially when a little allum is added to the liquor of its dye; it is not the ſame as when the wool or ſtuff has received the water for the ſcarlet-preparation in which no allum can enter, and conſequently when theſe ſort of colours are expoſed to the air, they ſadden in a ſhort time, that is, they loſe part of their orange colour, produced by the mixture of the yellow with the red, and the effect of the air upon this colour is the ſame, though it appears different from that on all others, &c. that it commonly turns them pale; yet this one darkens and browns them by taking away part of its bright orange. For it is demonſtrated by ſeveral chymical experiments, that there is a vitriolic acid in the air like unto that which may be extracted from allum. Now if a ſtuff dyed lobſter colour was to be paſſed through a light ſolution of allum, the acid of the ſalt would immediately ſadden it, and the red of the cochineal would eclipſe the orange dye; the ſame thing muſt then

then happen when ſuch a colour is expoſed to the air, which is impregnated with the ſame acid.

Very few ſhades are made from the crimſon and yellow, becauſe of the price of the firſt, and that pretty near the ſame ſhades are made with madder and kermes, yellow and half ſcarlet of grain, as well as from the yellow and half crimſon. It is with theſe different mixtures, that marigold, orange, gold yellow and other like ſhades are made, which are ſimply produced by the mixture of the yellow and red, and ſometimes by yellow alone.

CHAP. XXIII.

Of the MIXTURE *of* RED *and* BROWN.

THE reds of the kermes and cochineal are not uſed in this mixture, for madder has as good an effect on thoſe which cannot become bright, becauſe of the dark obſcure colour of the brown, but after they are maddered, they are dipt in the old liquors of cochineal or kermes; yet a liquor of theſe ingredients is ſeldom purpoſely prepared, being too dear for ſuch common colours which are as eaſily made with madder. The ſtuff is to be boiled with a quantity of allum and tartar, proportioned to the red ſhade of madder intended; it is then paſſed through a liquor of this root, and afterwards dipped and worked in a liquor of walnut roots or walnut rinds; the following colours will be produced, viz. cinnamon, tobacco, cheſnut, muſk, bear's hair, and numberleſs others, by varying the ground of the madder from the browneſt to the lighteſt, and keeping them longer or ſhorter in the liquor of the root. The proceſs may begin with any one of theſe colours, but the red is commonly

monly dyed firſt, as the liquor proper for the madder might hurt the brown, therefore they are not to be mixt as the red and yellow are ſometimes.

CHAP. XXIV.

Of the MIXTURE *of* YELLOW *and* BROWN.

FROM this mixture are produced the ſhades of ſeulemort and bear's hair.

Soot is commonly uſed in theſe colours inſtead of the rinds of walnuts, or the root of the walnut tree, as it makes them finer, but care muſt be taken that the wool or ſtuff be well ſcoured after it is dyed, to take off the bad ſmell of the liquor, for only the clear liquor of the ſoot is to be uſed, as has already been ſaid. The walnut rinds are preferable to the ſoot, unleſs obliged to match a pattern of ſeulemort with the greateſt exactneſs, and which may ſometimes be done with the walnut.

Theſe are the only two browns reſulting from theſe ſhades, the ſumach and the alder bark not giving ſufficient ground.

Wool muſt be boiled in allum and tartar to dye it yellow before it is made brown; but if it ſhould not have a ſufficient ground of yellow, it might be paſſed afreſh through the yellow dye, notwithſtanding it has been browned, though in fact this method of ſeeking exactly the ſhade does not make ſo laſting a colour as when the yellow was at firſt ſufficiently dyed, for when the yellow is dyed firſt, the brown is a great deal brighter.

C H A P. XXV.

Of the MIXTURE *of* BROWN *and* BLACK.

FROM this mixture a great number of colours may be extracted, as coffee, chesnut, prune, musk, thorn, and several like shades, whose numbers are almost infinite, and of great use. The method of working them is this:

After the wool or stuffs have been made brown as already described, and that several shades have previously been given; as for example, a stronger brown for the coffee, chesnut, &c. galls, sumach, and alder bark are put into a copper in proportion to the quantities of stuffs to be dyed; the whole is boiled for one hour, after which green copperas is to be added. The stuffs that are to be lightest, as the thorn, are first dipped in this liquor, then taken out, and others that are to be browner are put in, observing to add copperas to the liquor each time, and as occasion may require, which is known by its not browning the stuff quickly, thus continuing until all the stuffs are browned: the liquor must not boil, nor be of a greater degree of heat than the hand can bear.

When the galls and other ingredients are boiled, cold water is added to refresh the liquor before the stuff is put in: this is a precaution that is absolutely necessary, as I have often said. The stuffs are first to be dipped in luke-warm water before they are put into the copper, lest since they were browned they should have dried; and they must be aired when they have remained some time in the browning, by passing them between the hands by the lists, without which they would perhaps spoil, blot, and be unequally dyed, and the brown, for want of airing,

airing, would not be lafting, as there would not be a fucceffive congelation of the faline parts of the vitriol.

I have now fhewn all the neceffary colours or fhades which may be produced by the mixture of the primitive colours taken two by two, and have given a minute defcription both of their effects and the method of producing them. There being but few colours which may not be greatly varied, it depends on the judgment of the Dyer to choofe the eafieft, provided the colour be equally fine.

CHAP. XXVI.

Of the MIXTURE *of the* PRIMITIVE COLOURS, *taken three by three.*

FROM blue, red, and yellow, the red olives and greenifh greys are made, and fome other like fhades of little ufe only for fpun wool defigned for tapeftry. It would be a repetition to give the method of ufing thefe colours, having fufficiently explained it in the preceding pages.

In the mixture, where blue is a fhade, it is ufual to begin with it; the ftuff is afterwards boiled to give it the other colours, in which it is dipped alternately one after the other; notwithftanding they are fometimes mixed together, and are as good, provided they are colours which require the fame preparation; for example, the madder-red and the yellow. As to the cochineal and kermes, they are feldom ufed in thefe common colours, but only light colours which have a bloom or vinous hue, and which muft be bright and brilliant, and then they are only ufed in the laft liquor,

that is, the ſtuff is only dipped in when it has received the other colours, unleſs they are to be greyed a little, which is laſtly done by paſſing them through the browning. It is impoſſible to give any preciſe rules for this work, and the leaſt practice of theſe rules will teach more than I could ſay in many volumes.

Olives are made from blue, red, and brown, from the deepeſt to the lighteſt, and by giving a little ſhade of red, the ſlated greys, the lavender greys, and ſuch like.

From the blue, the red, and the black, an infinite number of greys of all ſhades are made, as the ſage grey, the pigeon grey, the ſlate grey, the lead grey, the king's and prince's colour, browner than uſual, and a variety of other colours almoſt innumerable.

From blue, yellow, and brown, are made the greens, gooſe dung, and olives of all kinds.

From blue, brown, and black are produced the brown olives and the green greys.

From the red, yellow, and brown proceed the orange, gold colour, marigold, feulemort, old carnations, burnt cinnamon, and tobacco of all kinds.

From the red, yellow, and black pretty near the ſame as the laſt, and the deep feulemort; as alſo the ox hair and brown nut, and others of the like kind.

I give this liſt of colours only as a table to ſhew in general what ingredients are made uſe of to make theſe ſorts of colours, which alſo partake of ſeveral others.

Four or five of theſe colours may be mixed together; however this is rarely done: a minute detail on this ſubject would be uſeleſs, becauſe all that may be done is oftentimes ſuperfluous. I ſhall now only relate the manner in which I have ſeen

about

about forty different ſhades of carnations made in ſpun wool; this example will ſhew what may be done in all other caſes. There were none of thoſe bright ſhades of ſcarlet in theſe which are made as in the chapter on that colour.

Variety of Carnation Colours.

All theſe fleſh or carnations were old carnations, or ſhades of it, ſo that they were all obliged to be taken from the mixture of the red of kermes, yellow, brown, and black.

An unequal preparation was firſt given to the wool, reſerving for the lighter ſhades thoſe whoſe preparing liquors had been weakeſt. When they had remained as uſual four or five days in the liquor, the lighter ſhades were dyed; theſe colours were diſpoſed in four different veſſels, which were always kept ſufficiently hot without boiling. A ſkain of wool was immediately dipped in the liquor of the kermes for a minute, it was taken out, wrung, and paſſed through a liquor of weld, and an inſtant after through a brown one, and it became of the colour required by the Dyer; he immediately dipped another, which remained a little longer in each liquor: he went on after this manner, and when, after being ſtrongly wrung, and ſeemed to want a little red or any other colour, he dipped it in the liquor which it appeared to want. By this method he brought all his colours to the deſired ſhade, and paſſed through the brown thoſe that were required to be deeper. I was fully perſuaded by this method of working, that only patience and practice were wanting to make all the colours which can be conceived.

Too much caution cannot be given in this kind of work, to begin always with the lighteſt ſhades,

for it often happens that they are kept too long in some of these liquors, and then that skain must be made into a darker shade. But when once the lighter shades are matched, and in a right degradation, the rest are easily made.

What I have been speaking of, relates only to wool intended for tapestry, when it is necessary that the shades be carried on with the greatest degree of precision, without which it would be impossible to imitate the flesh colours of the painter.

With regard to stuffs, it seldom or never happens that they are made in these gradations of shades, or that so many colours are mixed together; two or three are generally sufficient, since it has been shewn what a variety of colours arose from their combination, that even names cannot be found for them.

I think I have omitted nothing regarding the dying of wool or woollen stuffs in the great and good dye, and I make no doubt but that by exactly following what I have laid down, each colour and all the shades may be executed to the greatest perfection, as well in fleece wool, spun wool, as on stuffs manufactured in white.

I think it yet necessary to add something in regard to mixed stuffs, that is, whose wool is mixed before the manufacturing of the stuff, and to teach the method by which this mixture of dyed wool is performed, to be afterwards carded and spun to form a colour resulting from those different wools.

It may be objected that this article rather relates to the manufacturing of stuffs than their dyes; but to this I answer, that sometimes colours are made by mixing wool of different shades, whose colours would not easily be imitated by dying the stuff of a compound colour; some of these different

different ſhades are compoſed of ingredients which would require a different preparation; whereas by dying every part of the wool ſeparately, the mixture is made without any difficulty; it cannot therefore be improper here to give the manner of mixing together wool of different colours, and I ſhall alſo give the manner of making mixtures for an eſſay or proof in ſmall, (which is always neceſſary) to chooſe that which produces the moſt agreeable effect.

CHAP. XXVII.

Of the Manner of mixing WOOL *of different* COLOURS *for* CLOTHS *or* MIXED COLOURS.

[*Colours mixed in the Loom.*]

ONE example of the method of mixing (after the moſt exact manner poſſible) wool of different colours, will be ſufficient, and it will be eaſily applied in all other caſes required. Suppoſe a mixed cloth of a coffee colour to be made, the following is the method of the manufacturers of Languedoc, and pretty near the ſame is practiſed in all other manufactories.

Three hundred and fifty pounds of wool are firſt dyed coffee colour, which is called the ground wool, that is, that which prevails in the ſtuffs; after which are taken five pounds of wool dyed in madder-red or kermes, and two pounds dyed in king's blue; theſe laſt are called the wool of mixture. This wool is diſtributed to different perſons placed in a ring in a large room. The factor, or he that has the care of the mixture, ſtands

ſtands with a ſtick in his hand in the centre of this circle, the men being at ſix feet diſtance from him; eight or ten are generally employed at this work, and all the wool is given to them. In the preſent caſe, for example, ſix will be employed in bearing the prevailing wool or coffee colour, one the blue, and another the red; but they muſt be ſo ſituated that there may be three together who have the coffee coloured wool, then he that has the red, then three with the coffee colour, and laſtly he that has the blue. When there is a greater number of colours, they are thus equally diſtributed, obſerving to divide them, as much as poſſible, the one from the other.

The men thus diſpoſed walk ſlowly round the factor, keeping an equal diſtance, and each ſtep they take they caſt at the feet of the factor a ſmall lock of the wool they carry, with this difference, that thoſe that have the red or the blue, having but a ſmall quantity to diſtribute, fling but little each time, whereas the others muſt fling much more. The factor ſtirs the wool with his ſtick whilſt the men are flinging it, and that the mixture ſhould be perfect, they muſt all have diſtributed their wool at one and the ſame time. The factor then mixes it again, and gives it to the carders.

The carding makes a perfect mixture, ſo that no particular colour is to be diſtinguiſhed, and it appears of one uniform colour; it is afterwards ſpun, the cloth manufactured, and brought to the mill. The importance of this mixture being exactly made is eaſily conceived, for if theſe colours were unequally diſtributed, the cloth would appear full of blots.

As in the compoſition of theſe mixtures it is not poſſible to judge exactly of the effect which may be produced by the combination of all theſe

colours

colours in different proportions, I ſhall give a method of making a proof in ſmall, that a colour formed after this manner by a known proportional mixture, it may be executed in great, and be certain that the colour of the ſtuff will be equal to that of the pattern.

CHAP. XXVIII.

Of the Method of preparing the PATTERN FELTS, *or Mixture for an* ESSAY.

THIS little work is very ſimple and very uſeful, as it will ſhew in an hour what a mixt cloth will be after it is manufactured, and even when it is entirely dreſſed. For this purpoſe, wool of different colours are taken, and after having weighed each exactly, the mixture is made with the fingers in the proportion which is judged ſufficient, but the whole in a very ſmall quantity; ſo that the mixture being made, it may not exceed the bigneſs of the fiſt. This wool is then moiſtened with a little oil, and carded ſeveral times with ſmall cards, till all theſe colours are well incorporated together and perfectly well mixt. This wool, which is extremely open and of the ſquare form of the card, is folded four times, and gently preſſed between the hands. It is then plunged into a ſtrong ſoap water, and putting it again between the hands, it is ſtrongly preſſed at different times, ſtriking ſometimes one hand on the other. It is then gently rubbed betwixt the two hands, which hardens the wool by contracting it all manner of ways, and making it occupy leſs ſpace. It is then dipped again in the ſoap water, and continued to be felted, until it has acquired ſome conſiſtence, and that it becomes like

like felt, and pretty near the ſame conſiſtence as the common cloth. This felt is then a true copy of what the cloth will be after its manufacturing; for when it has been well felted, that is, that the wool has been equally and carefully extended under the hand coming from the card, it is as equal and as ſmooth as the cloth itſelf can be. To finiſh it alſo as perfectly as the cloth, after it has been waſhed to take off the ſoap, it is dried and put between two papers, and preſt with an iron ſomewhat hot: by this means it acquires a luſtre which makes it appear like a cloth which has been entirely dreſſed.

If the colour of the felt is approved of, the mixture in great is made for the cloth, by following the ſame proportions exactly, and it will certainly be like the pattern, for not only the wool of different colours are as entirely mixt and cloſed one to the other in the felt as in the cloth, but the ſoap which has been made uſe of to felt it, has produced the ſame effect as that which happens to the cloth in the fulling mill, for there are ſeveral colours, and particularly thoſe that have been browned, that is, in whoſe compoſitions there are ſhades of black and grey, which loſe in the mill part of their browning, ſo that it muſt always be dyed of a deeper colour than intended to be after finiſhing: this defect of ſolidity in the browning does not hinder it from ſtanding very well the action of the air, but it is eaſily ſpotted by acid liquors, as has been before ſaid. The colours that have been ſaddened in the woad or indigo vat are not liable to this, they ſcarce loſe any thing in the mill. The felt produces the ſame effect, and it is certain that the ſtuff will not loſe more in great at the mill than the felt did with ſoap: conſequently this preliminary operation of the felt may be looked upon as a ſure guide

guide for the choice and aſſortment of wool in mixt cloths.

Theſe patterns are made ſtill better with black ſoap, but it gives them a diſagreeable ſmell, which is not eaſily taken off by repeated waſhings.

The felts, when made, may be dyed for ſtuffs, in which it is required that one colour ſhould cover the other, for then, after the ſtuff ſhould have been mixt with the ſame colours as the felt, it might be dipt in the ſame dye through which that had been paſſed, and by this means it would be of the ſame colour as the felt; but this is not to be done to the ſtuff till it comes from the mill, has been ſheered, and nothing remains but to dreſs it. This method will be of great uſe when it is a mixt cloth in which cochineal has been uſed, for it ſaddens too much and ſpoils at the mill; ſo that when it is uſed in mixt ſtuffs, a freſh liquor muſt be made, in which the cloth muſt be dipt, when it requires no more dreſſing than that which is given to cloth dyed white after it is come out of the dye.

CHAP. XXIX.

POLISH RED.

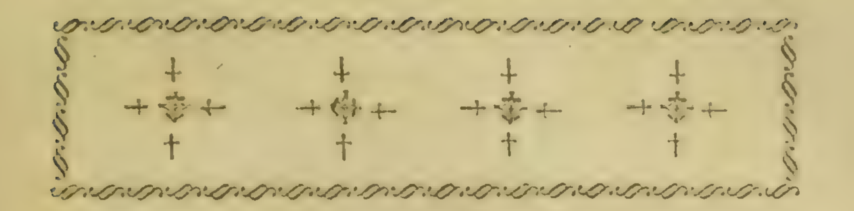
BEFORE I enter upon the colours of the leſſer dye, I ſhall give the proceſs of a very excellent colour, called Poliſh red.

If you would dye forty pounds of wool this bright and holding colour, boil ten pounds of nut galls, in a copper ſufficiently large, an hour and a half: then cool the liquor with cold water about ten degrees under a boiling heat, becauſe the madder ſhould not boil, and add beſt madder in proportion to the ſhade required, from fourteen to

twenty

twenty pounds. Work theſe ingredients with the wool for two hours with long poles, that it may dye in all parts alike. Rince it well, and you have the true Poliſh red. If you would have a dark colour, uſe a little aſhes. Obſerve to have the wool well ſcoured. This proceſs will hold good in cloth and other things.

THE



THE DYER's ASSISTANT.

PART II.

CHAP. I.

Of the DYING *of* WOOL *by the* LESSER DYE.

I Observed in the begining of this treatise, that the dying of wool, or woollen stuffs manufactured from it, were distinguished by the great and lesser dye. The French regulations have fixed what the quality of the wool and stuffs are to be, which are to be dyed by the great or lesser dye. This distinction has been founded on this principle, that stuffs of a certain value, and which generally constitute the upper part of cloathing, should receive a more solid and lasting colour than stuffs of a low price, which would be dearer and become less saleable, were they obliged to be dyed by the good dye, as the good dye is a great deal more expensive than the lesser, and that stuffs of low price, which are permitted to be dyed by the lesser dye, are generally used to make linings, so that they are little exposed to the action of the air, and if they are put to other uses they are soon worn out, on ac-

count of the weakneſs of their texture; and conſequently there is no neceſſity for their colours being ſo laſting as that of a ſtuff of a much longer duration.

I have related in the preceding treatiſe, with the greateſt exactneſs and preciſion in my power, the method of executing by the good dye all imaginable colours; I ſhall do the ſame in that which concerns the leſſer dye, and ſhall lay down the method of making the ſame colours with other ingredients than I have hitherto ſpoken of, and which, though they have not the ſolidity of the firſt, often have the advantage of yielding more lively colours; beſides which, the greater part give a ſmoother colour, and are worked with greater facility than the ingredients of the good dye.

Theſe are the advantages of theſe ſubſtances which are called falſe ingredients, and though it is to be wiſhed that their uſe was not ſo general, it muſt be agreed that they have their utility for ſtuffs leſs expoſed to the air, or whoſe colour does not ſtand in need of a long duration. I might alſo add, that the colours are moſt commonly ſorted with greater eaſe, and with more expedition, in the leſſer dye than can be done in the great.

I ſhall not follow the ſame order for this kind of dye as I did for the good, ſince in this no primary colours are known. Few ſerve as a ground for others: the greateſt part do not ariſe from a combination of two or ſeveral ſimple colours. In ſhort, there are colours, ſuch as the blue, &c. which are ſeldom or never made in the leſſer dye.

This is the order which I propoſe to follow, and ſhall firſt ſet forth the names of all the ingredients which particularly belong to the leſſer dye, and then give the method of uſing each of theſe ingredients, and the extraction of all the colours they can yield.

It

It will be found that ſeveral of theſe ingredients produce ſimilar colours, ſo that it would have been impoſſible to have treated of them ſeparately, without tiring the reader with tedious and troubleſome repetitions.

The ingredients are flock or goat's hair maddered, archil, logwood, brazil, fuſtic, roncou, grains of *Avignon*, turmeric, or *terra merrita*. I ſhall not here ſpeak of the ſanders or ſoot, though theſe ingredients particularly belong to the leſſer dye; I have already given the manner of uſing theſe laſt.

C H A P. II.

Of the DYING *of* FLOCK *or* GOAT's HAIR.

THERE are two preparations very different one from the other in the dying of flock: the firſt is with madder, and belongs to the great and good dye; the ſecond is to diſſolve it and make uſe of it; this belongs to the leſſer dye. The dying with flock was formerly permitted in the good dye, but was rather on account of its being extracted from madder, than by any experiment that had been made concerning its durability. I tried it with great attention, and found it beyond any doubt that there is no colour that reſiſts the air leſs. It is certainly for this reaſon that it was reſtrained to the leſſer dye in the new regulation of France in 1737. Yet, as by the ſame regulation, it is not permitted to the Dyers of the leſſer dye to uſe madder, nor even to keep it in their houſes: it has been enacted, that only the Dyers of the great dye ſhould be ſuffered to madder flock, and thoſe of the leſſer dye to diſſolve and uſe it.

This maddering of flock ought to have found a place in the foregoing treatise, but that I chose rather to class together all operations that have any necessary connection, than to stick too scrupulously to that distinction of the great and lesser dye, which is the particular object of the civil government of that art, and which upon some occasions might have made me fall into some obscurities, or run into continual repetitions; besides, the government of dying is not the art considered in itself.

To madder the flock or goat's hair, four pounds of either of them is cut and well separated, that the dye may penetrate the better. It is boiled two hours in a sufficient quantity of sour water; then it is drained for an hour, and put into a middling copper, half filled with water, with four pounds of roach allum, two pounds of red tartar, and one pound of madder. The whole is boiled for six hours, putting in hot water as the liquor wastes; it is left all night and next day in this liquor: the third day it is taken out and drained in a basket. Some Dyers let it remain eight days, but it often happens that by this delay in a copper vessel it is tarnished by the liquors corroding a part of the copper; a middling copper is then filled to the two-thirds with half sour water and half common water, and when the liquor is ready to boil, eight pounds of madder, well cut and crushed between the hands, is added. When the madder is well mixed in the liquor, four pounds of flock or hair is put in and boiled for six hours; it is then well washed, and the next day it is maddered a second time after the same manner, only putting in four pounds of madder instead of eight, which were before used. After this second maddering, it is well washed and dried; it is then almost black and fit for use.

It

It appears by this operation, that four pounds of flock or hair is loaded with thirteen pounds of the dye of madder, yet there ſtill remains ſome dye in the liquor, which is then called an old maddering, and which is preſerved for uſe on certain occaſions, as in tobacco, cinnamon colour, and ſeveral others.

When the flock is thus maddered by the Dyer of the great dye he ſells it to Dyers of the leſſer, who have then the liberty to diſſolve and uſe it: this is the common method, which has many difficulties, and is known but to few Dyers. Madder is hereby made fine.

About half an hour after ſeven in the morning, ſix pails full of clear water are put into a middling copper, and when the water is lukewarm, five pounds of pearl-aſhes are put in: the whole is boiled till eleven, and the liquor is then conſiderably diminiſhed, ſo as to be held in a leſſer copper, into which it is emptied, obſerving firſt to let the dregs of the pearl-aſhes ſubſide, that none but the clear may be uſed.

A pail full of this liquor is afterwards put into the middling copper, having firſt ſcoured it well, and a little fire made under it; the four pounds of maddered flock are ſcattered in it by degrees, and at the ſame time a little of the lukewarm and ſaline liquor of the ſmall copper is added to keep down the boiling, which riſes from time to time to the top of the copper, in which the operation is performing.

When all the flock and the liquor of the little copper are put into the middling one, a pail full of clear water is put on the dregs of the pearl-aſhes remaining in the little copper. This water ſerves to fill the middling one as the liquor in it evaporates. All this flock melts, or is diſſolved by the action of the pearl-aſhes, and after the firſt half

hour, not the least hair is to be perceived. The liquor is then of a very deep red. The whole is then boiled without any addition, till three in the afternoon, that the whole dissolution of the flocks may be the more exactly performed. Then a stick is placed upon the copper, and upon this stick is placed a pail of fermented urine, in which pail a small hole has been previously made towards its lower part, and a little straw put into it, that the urine may very slowly run into the copper; whilst it is running, the liquor is made to boil strongly, and this urine makes good what may be lost by evaporation. This operation continues five hours, during which time three pails full of urine are discharged into the copper, being made to run faster when the boil is stronger, than when moderate. It is here to be observed, that, on account of the small quantity of flock in the experiment which I lay down here, five pounds only of pearl-ashes are ordered; for when thirty pounds of flock are dissolved at one time, which is the common custom of the French Dyers, they put twelve ounces of pearl-ashes to each pound of flock.

During the whole time of this operation, a strong volatile smell of urine is emitted, and there swims on the surface of the liquor a brown scum, but much more so after the addition of the urine. The liquor is known to be sufficiently done when this rises no more, and that the boil rises but gently, that is what happened to the operation now related, at eight in the evening. The fire is then raked out, the copper covered, and thus left to the next day. Patterns had been taken at different times of the colours of the liquor from three to eight in the evening, by dipping in small pieces of paper: the first were very brown, and they became continually lighter, and united themselves more and more, in proportion

proportion as the volatile part of the urine acted on the colouring parts of the liquor.

Nothing now remained but to dye the wool in the liquor thus prepared, and which is called melting of flock; this is the easiest work belonging to the Dyer. A quarter of an hour before the dying is begun, a little piece of very clean roach allum is put in, and the copper is well raked to melt it. As this liquor which was in the middling copper had been covered the whole night, and the fire had not been put out, the liquor was still so hot as not to suffer the hand. The clearest was taken out and brought into a small copper, with a sufficient quantity of lukewarm water, some wool dyed yellow with weld was dipped in; it immediately became of a fine orange, bordering on the flame colour, that is of the colour called *nacaret*, and known to the Dyers by the name of *nacaret of flock*, because it is commonly made with melted flock.

Twenty hanks of white wool were dipped one after the other in the same liquor, beginning by those that were to have the deepest ground, and leaving them longer or shorter in the liquor according to the shade required. An assortment was made after this manner from the nacaret, or bright orange red, to the cherry colour. It ought to be observed, that in proportion as the liquor was consumed, fresh was taken from the middle-sized copper, great care being taken not to stir the sediment at the bottom; a little fire was also kept under the small copper, to keep the liquor always in the same degree of heat. The wool is thus dipped until the whole liquor is used, and all the colour drawn out. But the lighter colours could not be dyed in it; for when the colour of the liquor is once weakened, as it ought to be for these colours, it is generally loaded with filth, which would take off the brightness required in these shades.

The

The following is the method of making ſhades lighter than the cherry colour. A copper is filled with clear water, and five or ſix hanks of wool dyed of the deepeſt dye from the flock, that is, from the ſhade that immediately follows the nacarat, are put in. As ſoon as the water boils, it takes out all the colour the wool had, and it is in this freſh liquor that the other wool that is to be dyed is dipped, from the cherry colour to the paleſt fleſh colour, obſerving always to begin by the deepeſt ſhades.

Moſt of the Dyers who do not know how to melt the flock, or who will not give themſelves that trouble, buy ſome pounds of this ſcarlet of flock, which they uſe after this manner, to make all the lighter ſhades, which, as has been ſaid, is done with much eaſe. This operation ſhews what little dependance can be put on the ſolidity of a colour that paſſes ſo quickly in boiling water. And in fact, it is one of the worſt colours there is in dying, and on that account the new regulation has taken it from the great dye, and permits it in the leſſer for the reaſons above mentioned.

Thus a very bad colour may be had from an ingredient which, of all thoſe that are uſed in dying, is perhaps the beſt and the moſt durable; yet when this hair, dyed with all the neceſſary precautions to inſure the colour as much as poſſible, comes to be diſſolved or melted in a liquor of pearl-aſhes, its colour, by acquiring a new luſtre, loſes all its ſolidity, and can only be ranked in the number of the falſeſt dyes.

It may appear that the little ſolidity of this colour proceeded from the wool having no preparation, and retaining no ſalt before its being dipped in the diſſolved flock; but I found that this was not the cauſe; for I dipped in this liquor wool boiled

boiled as uſual, and other wool differently prepared, without finding that the colour of the latter had acquired any more ſolidity; the luſtre was leſs, that is, it came out more ſaddened than the wool that had been dyed in it without any preparation.

Though I have ſaid that wool receives no preparation before its being dyed in a diſſolution of flock, it is nevertheleſs neceſſary to ſulphur thoſe that are to make clear ſhades, for that gives them a great brightneſs and luſtre, as the diſſolved flock is applied on a ground a great deal whiter than it would be without the vapour of the ſulphur, which cleanſes it of all its filth. The ſame thing is done for the light blues, and for ſome other colours; but this operation is ſeldom made uſe of but for wool intended for ſamples or tapeſtry.

Sulphuring of Wool.

The Dyers do not do this, becauſe of the ſtink of the ſulphur, or rather to avoid the trouble. Nevertheleſs, to give an idea of it, the white wool is ſuſpended on hoops or perches in a cloſe room, and under this wool chafing-diſhes are placed with lighted coals, on which powdered ſulphur is caſt. The room door is afterwards ſhut, that the ſmoke may be the longer retained and act on the wool, which is to remain till it is entirely whitened; it s then called ſulphured wool; and this is the preparation it muſt receive to give a brightneſs to the roſe, cherry, and fleſh colours, which are made from the diſſolution of flocks.

The Theory of the Diſſolution of Flock.

The reaſon why from an ingredient, ſuch as the root of madder, periſhable colours are produced from

from diſſolved flock, is not difficult to aſſign. In the firſt operation of maddering the flock, the red of the madder was fixed in the hair by the preparation of allum and tartar as much as poſſible, but as it is overloaded with this colour, it is eaſy to conceive that the ſuperfluous colouring atoms being only applied on thoſe which already filled the pores of this hair, theſe alone are really retained in the pores, and are cemented by the ſalts. The hair thus reddened by the madder ſo as to become almoſt black, would loſe a great deal of the intenſity of its colour, if it was boiled in any liquor, was it even common water; but to this water, pearl-aſhes are added in equal weight with the flock already dyed, which is to be melted in it; conſequently there is a very ſtrong lixivium of fixed alkaline ſalts made. I have already ſaid in another place, in the foregoing treatiſe, that very ſtrong alkaline leys deſtroy the natural texture of almoſt all animal ſubſtances, as alſo gums and rezins; in ſhort, that an alkaline ſalt is their diſſolvent. In the preſent operation, the lixivium of the pearl-aſhes is very concentrated, and very acrid, and conſequently in a ſtate to melt the hair, which is an animal ſubſtance, which it does very quickly, and with a ſtrong fermentation, which ſhews itſelf by the ſtrong and violent elevation of the liquor; conſequently it deſtroys the natural texture of each of theſe hairs, and the ſides of the pores being at the ſame time broken and reduced to very minute parts, theſe ſides have neither conſiſtence nor ſpring to retain the ſalts, and the colouring particles that were ſticking to them. Therefore the animal particles of the hair, the colouring parts of the madder, the ſaline parts of the liquor, and the alkali of the pearl-aſhes, are all confounded together, and form a new mixture, which cannot afford a laſting

dye,

dye, becauſe from theſe ſaline parts mixed together there cannot be formed a ſufficient quantity of ſalts capable of chryſtalization, and producing moleculas, which can reſiſt cold water and the rays of the ſun. In ſhort, it could not form a tartar of vitriol, becauſe the alkaline ſalt is in too great a proportion.

To rouze the deep and overloaded dye of the madder firſt applied on the flock, and after confounded by the melting of this hair in the mixture already ſpoken of, putrified urine is added in a conſiderable quantity; this is a further obſtacle to chryſtalization; conſequently wool not prepared by other ſalts, and dipped in a liquor thus compoſed, can only be covered by a ſuperficial colour, which finds no prepared pores, or any thing ſaline in thoſe pores, which may cement the colouring atoms; therefore ſuch a dye muſt quit its ſubject on the leaſt effort of what nature ſoever it be.

But wool prepared by the liquor of tartar and allum, does not take a more laſting colour, in the liquor of the melted flock, than wool not prepared by theſe ſalts; for a liquor which abounds with fixt alkaline ſalts attacks the tartar left of the preceding preparation in the pores of the wool. This tartar changes its nature, and from being hard to diſſolve, as it was before, it becomes a ſoluble tartar, that is, a ſalt that diſſolves very eaſily in the coldeſt water.

It may perhaps be objected, that particles of allum remain in the pores of the prepared wool, that from theſe particles of allum, as well as from a portion of the ſame ſalt which is put into the liquor, reddened by the melting of the flock, the alkali of the pearl-aſhes muſt form a tartar of vitriol, which, according to my principles, ought to ſecure the dye.

To

To this I anſwer, that the urine hinders the combination of theſe two ſalts, which is neceſſary for the formation of the tartar of vitriol; if even this hindrance did not exiſt, the quantity of this ſalt, which I have named *hard* in another place, could not be ſufficient to cement the colour in the pores of the wool, or put them in a ſtate to retain the colouring atoms. Further, the ſharpneſs of the alkaline ſalts in this liquor, which is capable of intirely diſſolving the hair boiled in it, would equally be able to diſſolve the wool, were it boiled as the flock was. But yet, though a degree of heat is not given to the liquor, which would be neceſſary for this total deſtruction, it is eaſily conceived, that if the ſum of the deſtroying action is not the ſame, at leaſt a part exiſts, which is ſtill ſufficient to corrode the ſides of the pores of the wool, to enlarge them greatly, and to render them unfit to retain the colouring atoms; to this may be added, that the hair is melted in the liquor, and conſequently mixt with the colouring parts of the madder in a great quantity; that theſe are heterogeneous parts, which prevent the immediate contact of theſe ſame colouring parts, and that from all theſe obſtacles taken together, the colour muſt be rendered leſs durable and leſs holding than any of the leſſer dye. This, experience ſufficiently proves, for if a ſkain of red wool, dyed in this manner, be put into boiling water, the colour will be taken off intirely.

CHAP.

CHAP. III.

Of the Manner of using ARCHIL.

ARCHIL is a soft paste, of a deep red, which being simply diluted in hot water affords a number of different shades; there are two kinds, the most common, which is not so fine or so good, is generally made in Auvergne, of a lichen or sort of moss, very common on the rocks of that province: it is known under the name of Archil of Auvergne, or Land Archil. The other is a great deal finer and better; it is called the Archil of Herb, or of the Canaries, or Cape Verd Archil; it is prepared in France, England, Holland, and other places.

The workmen who prepare this herb archil, make a secret of the preparation, but the particulars may be found well related in a treatise of M. *Pierre Antoine Micheli*, which bears for title, *Nova Plantarum Genera*, therefore I shall not here give the method of preparing it.

When a Dyer wants to assure himself that the archil will produce a beautiful effect, he must extend a piece of this paste on the back of his hand and let it dry, afterwards washing his hand with cold water. If this spot remains with only a little of its colour discharged, he may judge the archil to be good, and be assured it will succeed.

I shall now give the method of using the prepared archil, but I shall only treat of that of the Canaries, and just mention the difference between it and that of Auvergne. A copper is filled with clear water, and when it begins to be luke-warm, the proper quantity of archil is put in and well stirred: the liquor is afterwards heated almost to boiling, and the wool or stuffs are dipt without any

preparation, only keeping those longer in that are to be deeper.

When the archil yields no more colour at this degree of heat, the liquor is made to boil to extract the remainder; but if it is archil of Auvergne, the colours drawn after this manner will be sadder than the first, on account of the boiling of the liquor. The Canary archil, on the contrary, will lose nothing of its brightness, if even the liquor boiled from the beginning. This last, though dearer, yields much more dye, so that there is more profit in making use of it, besides its superiority over the other in beauty and goodness of colour. The natural colour which is drawn both from the one and the other archil, is a fine *gris-de-lin*, bordering on the violet. The violet, the pansy, the amaranth, and several like colours are obtained from it, by giving the stuff a ground of blue more or less deep before it is passed through the archil.

It must here be observed, that to have the clear shades of these colours as bright as they ought to be, the wool ought to be sulphured, as was said in the foregoing chapter, either before it is dipped in the archil for the *gris-de-lin*, or before it is dyed blue for the violet and other like colours.

This way of using archil is the simplest, but the colours that proceed from it are not lasting. It may be imagined that the colours would be better by giving a preparation to the wool previous to its being dyed, as is practised in the great dye, when madder, cochineal, weld, &c. are used; but experience shews the contrary, and I have used the archil on wool boiled in allum and tartar, which did not resist the air more than that which had received no preparation.

There is, notwithstanding, a method of using the Canary archil, and giving it almost as much duration

duration as the moſt part of the ingredients of the good dye; but then its natural colour of *gris-de-lin* is taken off, and it acquires a red or ſcarlet, or rather a colour known under the name of baſtard ſcarlet. The colours of the kermes or Venetian ſcarlet, and ſeveral other ſhades that border on the red and the orange, may alſo be drawn from it. Theſe colours are extracted from the archil by the means of acids, and all thoſe that are thus made may be looked upon as much more laſting than the others, though, ſtrictly ſpeaking, they are not of the good dye.

There are two methods of extracting theſe red colours from the archil. The firſt is by incorporating ſome acid in the compoſition itſelf that is made uſe of to reduce this plant to a paſte (ſuch as is known to the Dyers under the name of archil). I have been aſſured that it may be made violet and even blue, which probably is done by the mixture of ſome alkalis, but I muſt confeſs I could not ſucceed in it, although I made above twenty trials for that purpoſe. I ſhall now proceed to the ſecond method of extracting from archil a beautiful and pretty laſting red, and which I executed four times with ſucceſs.

Baſtard Scarlet by Archil.

Prepared archil from the Canaries is diluted as uſual in warm water, and a ſmall quantity of the common compoſition for ſcarlet is added, which is, as has been ſhewn in the preceding treatiſe, a ſolution of tin in *aqua-regia*, weakened with water; this acid clears the liquor immediately and gives it a ſcarlet colour. The wool or ſtuff is then to be dipped in this liquor, and left till it has received the ſhade required. If the colour ſhould not have

P 2 brightneſs

brightneſs enough, a little more of the compoſition muſt be put in, and pretty near the ſame method muſt be followed as in the dying of common ſcarlet: I tried to make it in two liquors as the ſcarlet, that is, to boil the ſtuff with the compoſition, and a ſmall quantity of archil, and afterwards to finiſh it with a greater quantity of both, and I ſucceeded equally; but the operation is longer after this manner, and I have ſometimes made as fine a colour in one liquor. Thus the Dyer may take his choice of either of theſe methods.

I cannot exactly fix the quantity of ingredients in this operation. Firſt, As it depends on the ſhade that is to be given to the ſtuff. Second, As it is a new proceſs in dying, I have not had ſufficient experiments to know with exactneſs the quantity of archil and compoſition which ought to be uſed: the ſucceſs alſo depends on the greater or leſſer acidity of the compoſition. In ſhort, this method of dying with archil is ſo eaſy, that by making two or three trials in ſmall, more knowledge will be acquired from it than I could teach in a large volume: I muſt only add, that the more the colour drawn from this ingredient approaches the ſcarlet, the more laſting it is. I have made a great number of ſhades from the ſame archil, and which conſequently only differed by the greater or leſs quantity of the compoſition, and I always found that the more the archil went from the natural colour, the more laſting it became, ſo that when I brought it to the ſhade known by the name of baſtard ſcarlet, it withſtood the action of the air and eſſay proof almoſt as well as that which is commonly made with cochineal or madder.

If too much compoſition be put in the liquor, the wool will become of an orange colour, and diſagreeable.

disagreeable. The same thing also happens with cochineal, so that this is not an inconvenience peculiar to this dye; besides it is easily avoided by proceeding gradually in the addition of the composition, and by putting a small quantity at first.

I have tried the different acids in this scarlet composition, but none succeeded well; vinegar did not give a sufficient redness to the liquor, and the stuff dyed in it only took a colour of lees of wine, which even was not more lasting in the air than that of the archil in its natural state, and other acids saddened the colour. In short, it appears that (as in scarlet with cochineal) a metallic base extremely white must be united to the red of the archil, and this basis is the calx of tin. I have repeated the same operation with the archil of Auvergne, but the colours were not near so fine or so good.

CHAP. IV.

Of LOGWOOD *or* CAMPEACHY.

THE campeachy wood, known under the name of logwood, is of great use in the lesser dye, and it were to be wished that it was not used in the good dye, for the colour which that wood produces loses its brightness in a short time, and even disappears in some places on being exposed to the air; the low price of this drug in some measure tolerates its use; but the principal reason of using it is, that by the means of different preparations and salts it affords a great number of colours and shades, which are not easily made by the ingredients of the good dye alone. Yet it is possible, as I have said before, to make all these colours without the help

of logwood; therefore it was proper to forbid the uſe of this ingredient in the good dye.

Logwood is neceſſary to ſoften and velvet the blacks; it is this velvet hue that gives that excellency to the Sedan blacks. I ſhall now add ſome little matter concerning the other colours in which this wood is uſed, and I ſhall obſerve, that when any wood whatſoever is uſed in dying, it muſt be cut into ſmall ſhavings or chips, and put into a bag, that it may not ſtick to the wool or ſtuffs; for the rough chips will not only tear the goods, but blot them in thoſe places to which they ſtick.

Logwood is uſed with galls and copperas for all the ſhades of grey which border on the ſlate or lavender, the pigeon grey, the lead grey, and ſuch like. To make theſe, a copper is filled with clear water, and a proper quantity of galls is added; this muſt be proportioned to the quantity of ſtuffs to be dyed, and to the depth of the ſhade required. A bag of logwood is put into this liquor, and when the whole has boiled and cooled, the ſtuff is dipped in it, adding by little and little ſome copperas previouſly diſſolved in water. I cannot fix any exact proportion of ingredients, as the Dyers of the leſſer dye are not accuſtomed to weigh them; they work by the eye, and their buſineſs being to match low-priced ſtuffs for linings of cloths for which they have the patterns, they firſt make them lighter than is wanted, and ſadden them by adding copperas till they are come to the ſhade required. If they find there is not logwood ſufficient, they add more; they do the ſame when they have ſeveral ſtuffs to paſs through the ſame liquor, when they find the wood they have given has yielded all its dye. This work is not difficult, and only requires practice to judge pretty nearly the quantity of ingredients to be uſed, and to judge by the ſtuff, while wet, whether,

when

when dry, it would have the intended colour, which is done by ſtrongly wringing the end, and blowing on it ſtrongly; by this means, the greateſt part of the humidity, which has by twiſting been brought to the ſurface of the ſtuff, is driven off; then for an inſtant the colour is ſeen pretty nearly ſuch as it will be when dry; but this muſt be done by a quick eye, for in a moment after the adjacent moiſture is communicated to this dry place, and then you may be deceived.

A pretty fine violet is alſo made with logwood, by firſt boiling the wool as uſual with allum and tartar, and afterwards paſſing it through a liquor of logwood in which a little allum is diſſolved. But it is made much finer by bluing and alluming the ſtuff firſt, then dipping it in a liquor of Brazil mixt with a little logwood; this violet, though of the leſſer dye, is much better than the former, becauſe the blue ground always ſuſtains the colour, and makes it more holding.

The logwood alſo affords a blue colour, but it laſts ſo ill that this wood is ſeldom uſed for dying blue. Yet if from curioſity you wiſh to make a trial, you need only prepare a liquor with logwood, and mix a little cyprus or blue vitriol in it, and dip the ſtuffs in this without any other preparation, and you have a fine blue.

By the ſame means, green may be made in the ſame liquor. For this purpoſe, logwood, French berries or grains of Avignon and verdigriſe are put into a copper; this mixture gives the liquor a beautiful green colour; the wool may be then dipt to the height deſired, and may be of any deſired ſhade, by putting in more or leſs of the logwood and Avignon grains. But this colour is not better than the blue, and both ought to be excluded the art of dying: I have given the proceſs, merely that I might

I might omit nothing which came to my knowledge concerning the art.

The use to which logwood is most commonly applied in the lesser dye is for plumb, prune colours, purples and their shades.

This wood joined with galls, readily gives all its colours to wool that has had a ground of blue; it is saddened with a little green copperas, which browns them, and by this means some shades may be easily obtained which are much more difficult to hit in the great dye, as the different degrees of saddening are much more difficult to match in a blue vat, than by the help of the iron of the copperas. But these colours fade away very soon in the air, and in a few days a great difference is seen between the parts that were exposed to the air and those that were covered.

Having experienced, as I said in the preceding chapter, that the scarlet composition changed the colour of the archil, and made it more lasting, I tried what effect it might produce on the logwood; but what appeared singular to me was, that whatsoever quantity of composition I put into this liquor, it never lost its violet colour. Being desirous to put this to a further trial, I dyed a piece of cloth with logwood, and put into the liquor a quantity of composition, pretty nearly equal to that which I would have put for an equal dose of archil: the cloth took a pretty good violet colour. This cloth was put in the weather for twelve summer days, and the colour proved no better than if no composition had been used. By adding a small quantity of chrystals of tartar to another liquor composed as the former, I had a more lasting colour, but considerably different.

The Raven Grey.

The raven grey on worſted or ſtuffs is performed in the following manner.

In a copper ſufficiently large for ſixty pound weight, diſſolve eight ounces of allum, and work the worſted on ſticks very quick for the ſpace of half an hour at a boiling heat; then take it up, and add to the ſame liquor three or four pounds of copperas, and work it at a boiling heat for half an hour longer; while this is performing, the worſted muſt be waſhed, and one pail full of logwood chips muſt be boiled in another copper about twenty minutes; the worſted muſt then be turned very quick in the logwood decoction about half an hour, when it muſt be taken out, and returned about ten or fifteen minutes in the decoction of allum and copperas, as at firſt. This laſt operation is abſolutely neceſſary, as it contributes much to the beauty and luſtre of the colour, by diſcharging the groſs particles of the logwood, and leaves a beautiful raven grey. This proceſs will hold good for thin goods and coarſe cloth, but a leſs proportion of logwood will do.

C H A P. V.

Of SAXON BLUE *and* GREEN.

I Place here among the leſſer dyes that called Saxon blue and green, which has been for ſome time greatly in faſhion, being finer and brighter than any blue or green hitherto known either in the greater or leſſer dye, but it bears no proof, and in

in twelve days expoſition to the ſun, it loſes a great part of its colour.

Blue on Cloth, Stuff, or Yarn.

Put into a glazed earthen pot four pounds of good oil of vitriol, with twelve ounces of choice indigo very finely ground and ſifted; ſtir this chymical mixture very haſtily and frequently in order to excite a fermentation, and break the lumps with a ſtick whoſe bark has been ſtript off. It is cuſtomary with ſome Dyers to put into this compoſition a little antimony or ſalt petre, tartar, chalk, allum, or other things; but I find it ſufficient to mix the oil and indigo alone, and the colours will be finer, for thoſe neutral ſalts deſtroy the acid of the vitriol and ſully the colour. In twenty-four hours it is fit for uſe; then a copper of a good ſize is to be filled with fair water, (into which one peck of bran is put in a bag) and made pretty warm; the bran, after yielding its flower, muſt be taken out, and the chymic mixed well with water in a piggin is put in according to the ſhade required, having firſt put in a handful of powdered tartar; the cloth, &c. is to be well wet, and worked very quick over the wynch for half an hour. The liquor muſt not be made hotter than that for madder red. Obſerve, the hot acid of the vitriol would cauſe the blue to incline to green if too much heat was given. The cloth, ſtuff, or yarn muſt be turned in this liquor very quick for half an hour, and having been previouſly very well ſcoured, the colour will be brilliant and fine; it is beſt after waſhing to dry this colour in the ſhade.

Chymic

Chymic for Green.

Eight ounces of indigo is ſufficient for four pounds of oil for green, becauſe this mixture works green (and would even dye a pea-green if uſed very hot) and therefore would not do for blue. The indigo is better ſuſpended in this mixture than in the former, and is ſuppoſed to go further in green. The goods being well ſcoured are to be allumed; for every twenty pound weight, two pounds of allum is to be put into a copper with fair water, and the goods boiled gently an hour and a half; whilſt this is performing, another copper is got ready, in which fuſtick chips are put to boil; if there are any to dye pea-green it is beſt to dye them firſt, not as practiſed in ſome dye-houſes, for this great reaſon, that when ſeveral parcels of goods have been through the ſame liquor, there remains a ſcurf which the acid extracts, and that is ſure to ſtick to the next parcel that goes in; and if pea-green was the laſt, the colour would be ſullied thereby. The greens (pea-green excepted) are to be turned about ten minutes in the allum liquor after they are dyed, in order to clear them of the ſtuff, and render the colour brighter. The allum liquor is not to be hotter than that the hand may be borne in. Obſerve, if the allum was put in (as is cuſtomary in ſome dye-houſes) with the fuſtick, it would retard its working ſo well; for allum, being an acid, would diſcharge if uſed with, as well as prepare for fuſtick.

The reader will perhaps think me too tedious in this proceſs, and ſay (becauſe he is not uſed to this method) it is a ſuperfluous work; but be aſſured that the time loſt in the proceſs will be ſaved in the fuſtick, if attention is paid.

CHAP.

CHAP. VI.

Of BRAZIL WOOD.

UNDER the general name of Brazil wood is comprehended that of Fernambouc, St. Martha, Japan, and ſome others which I ſhall not here diſtinguiſh, ſince they are all uſed after the ſame manner for dying. Some give greater variety of colours than others, or finer; but this often proceeds from the parts of the wood being more or leſs expoſed to the air, or that ſome parts of it may be rotted. The ſoundeſt or higheſt in colour are to be choſen for dying.

All thoſe woods give a tolerable good colour, either uſed alone, mixt with logwood, or with other colouring ingredients. It has been ſhewn that, in the falſe or baſtard violet, a little Brazil was added to the logwood; but in the vinous greys, or thoſe which have a caſt of the red, a great deal more is uſed. Sometimes only, a ſmall quantity of galls is put with the Brazil, and it is ſaddened with copperas; often alſo logwood, archil, or ſome other ingredient, is added, according to the ſhade, from whence it is not poſſible to give any fixt rule for this kind of work, on account of the infinite variety of ſhades which are obtained from theſe different mixtures.

The natural colour of the Brazil, and for which it is moſt uſed, is the falſe ſcarlet, which appears fine and bright, but far inferior to the brightneſs of the cochineal or gum lacque.

To extract the colour from this wood, the hardeſt water, ſuch as will not diſſolve ſoap, muſt be made uſe of, for river water has not nearly ſo good an effect; it muſt be cut into chips and boiled

boiled for three hours; the water is then taken out and put into a large veſſel, and freſh well water put on the wood and boiled again for three hours; this water is added to the firſt.

This liquor, which is called juice of Brazil, muſt be old and fermented, and rope like an oily wine before it is fit for uſe. To extract a bright red from it, the ſtuff muſt be filled with the ſalts of the common liquor of preparation, but the allum muſt predominate, for the tartar alone, and alſo ſour water, greatly ſpoils the beauty of this colour: in ſhort, acids are hurtful to it, and diſſolve its red colouring part. Four ounces of allum for each pound of ſtuff is to be added to the liquor, and only two ounces of tartar, or even leſs. The wool is to be boiled in it for three hours; it is then taken out and gently wrung, and thus kept moiſt for eight days at leaſt, that by the ſalts being retained it may be ſufficiently prepared to receive the dye. To dye with this, one or two pails full of the old juice of Brazil is put into a convenient copper, and well ſcummed. Dip the ſtuff which has remained eight or ten days moiſtened in the preparing liquor, and it muſt be well worked in it without making the liquor boil too ſtrongly, until it be ſmoothly and equally dyed. Care muſt be taken to wring a corner of this ſtuff now and then, as I have already ſaid, to judge of its colour, for, whilſt wet, it appears at leaſt three ſhades deeper than when dry. By this method, which is ſomewhat tedious, very bright reds are made, perfectly imitating certain colours the Engliſh ſell under the name of Campeachy ſcarlets, which, by the proof of dyes, are not found to be better than this, only that they ſeem to have been lightly maddered.

This red, of which I have given the proceſs, and which is no where elſe deſcribed, withſtands

the weather three or four months in the winter, without losing any of its shade; on the contrary, it saddens, and seems to acquire a ground, but it does not stand the proof of tartar.

Some Dyers of the great dye use Brazil to heighten the red of madder, either to save this root, or make its red more bright than usual. This is done by dipping in a Brazil liquor a stuff, begun with the madder, but this kind of fraudulent dye is expresly forbid by the French regulations, as well as any mixture of the great dye with the lesser, because it can only serve to cheat, and to pass for a fine madder red, a colour which in a few days loses all its brightness along with the shade, which has been drawn from the Brazil, prepared in the common manner.

The first colour extracted from this wood is not of a good dye, probably because it is an indigested sap, and whose colouring particles have not been sufficiently attenuated to be retained and sufficiently fixt in the pores of the wool dyed in it. When these first gross parts of the colour have been carried off, those that remain in small quantity are finer, and mixing themselves to the yellow parts, which are furnished by the pure woody parts, the red resulting from it is more lasting.

By the means of acids, of what kind soever, all the red colour of this wood is carried off or disappears; then the stuff that is dyed by it takes a hind colour, more or less deep in proportion to the time it is kept in the liquor, and this colour is of a very good dye.

It is said that the Dyers of Amboise have a method of binding the Brazil colour in this manner; after their stuffs lightly maddered have been passed through a liquor of weld, and consequently boiled twice in allum and tartar, they put arsenic and

and pearl-ashes in the juice of Brazil, and it is asserted that this colour then resists the proofs; I tried this process, but it did not not succeed.

When a very bright red is required from the Brazil, I know by experience that it is possible to insure the colour drawn from it after such a manner that, having exposed it thirty days to the rays of the summer's sun, it will not change; but these kind of colours are coffee and chesnut purples.

To make these, I keep the stuff moistened in its liquor in a cellar for fifteen days; this liquor is prepared as for the reds, of which I have heretofore spoken; I fill a copper to two-thirds with well water, and the remaining third up with Brazil juice, to which I add about one ounce of Aleppo galls in very fine powder to every pound of stuff, and then boil it one or two hours, as I want the shade to be in deepness: the stuff is aired from time to time, and when it has taken the colour desired, it is well cooled before it is washed. This stuff being brushed, the nap layed, and cold-pressed, comes out very fine and very smooth.

CHAP. VII.

Of FUSTIC.

THE fustic gives an orange colour that is not lasting; it is commonly used in the lesser dye, like the roots or husks of walnuts, without boiling the stuff, so that it is easily managed. It is often mixt with walnut husks and weld, to make tobacco and cinnamon colours, and other like shades. But this wood is a very bad ingredient, for its colour being exposed to the air for a very

ſhort time loſes all its brightneſs and the greateſt part of its yellow ſhade.

If a ſtuff dyed with fuſtic is dipt in the woad vat, a diſagreeable olive enſues, which does not reſiſt the air, but ſoon loſes its colour.

I have already ſaid that fuſtic was made uſe of in Languedoc for making of lobſter colours for foreign markets, as it greatly ſaves cochineal. For this purpoſe they mix weld, fuſtic, and cochineal, with a little cream of tartar, in the ſame liquor, and the ſtuff boiled in this liquor comes out of a lobſter colour, and accordingly, to the quantity of theſe different ingredients, it becomes more or leſs red, tending to the orange. Although the method of mixing together ingredients of the good with thoſe of the leſſer dye ought to be condemned, yet in this caſe, and for this colour only, which is in conſiderable demand in the Mediterranean, it appears that the fuſtic may be tolerated; for having attempted to make the ſame colour, with only the ingredients of the good dye, I did not get a more laſting colour.

The change which the air produces in the lobſter colour made with fuſtic is very ſenſible, but it is not ſo diſagreeable as the changes incident to ſeveral other colours; for all the ſhade goes off and weakens at once, ſo that it is rather a diminution than a change of colour; whereas the lobſter colour made with the yellow wood becomes of a cherry colour.

CHAP.

CHAP. VIII.

Of ROUCOU.

THE roucou or racourt is a kind of dry paſte brought from America; this ingredient gives an orange colour pretty near the ſame as the fuſtic, and the dye is not more laſting. However it is not by the proof allum that the quality of the roucou is to be judged, for this does not in the leaſt alter its colour; on the contrary, it becomes finer and brighter, but the air carries it off, and effaces it in a ſhort time; ſoap has the ſame effect, and it is by this it muſt be tried according to the inſtructions on theſe kind of proofs. The place of this ingredient is eaſily ſupplied in the good dye by weld and madder mixt together, but roucou is made uſe of in the leſſer dye after the following manner.

Pearl-aſhes are diſſolved in a copper with a ſufficient quantity of water; it is well boiled for one hour that the aſhes may be totally diſſolved; then as many pounds of roucou as there are of aſhes, are added; the liquor is well raked and ſuffered to boil for a quarter of an hour; the wool or ſtuffs that are to be dyed are then dipt without any preparation, except dipping them in luke-warm water, that the colour may ſpread itſelf equally.

They are left in this liquor, working them continually until they are come to the deſired ſhade, after which they are waſhed and dried.

The roucou is often mixt with other ingredients of the leſſer dye, but I cannot give any inſtructions on theſe mixtures, as they depend on the ſhades you wiſh to make, and are in themſelves attended with no difficulty.

I have boiled the ſtuff in allum and tartar before I dyed it with roucou, but though the colour was more laſting, it was not ſufficiently ſo to be deemed of the good dye. On the whole, the roucou is a very bad ingredient for dying of wool, and is not made much uſe of, for it is dear, and other ingredients, that are cheaper and held better, are uſed in its ſtead.

Wool dyed with roucou, and afterwards dipt in the indigo or woad vat, takes a reddiſh olive, which in a very ſhort time becomes almoſt blue in the air, the colour given by the roucou diſappearing.

CHAP. IX.

Of the GRAINS *of* AVIGNON.

THE grains of Avignon are but little uſed in dying, they give a pretty good yellow, but not laſting, no more than the green, produced by dipping in the ſame liquor a ſtuff that has a ground of blue. To work it, the ſtuff muſt be boiled in allum and tartar as for weld. Then a freſh liquor is made with theſe grains, and the ſtuff is dipt, and muſt lie in it longer or ſhorter, according to the ſhade that is wanted. There is no difficulty in working of it, ſo I need only obſerve that it ought never to be uſed but when all other ingredients for dying yellow are wanting; this muſt ſeldom happen, as they are neither ſcarce nor dear.

CHAP.

C H A P. X.

Of T U R M E R I C.

THE turmeric is a root that is brought from the Eaſt-Indies; that which comes from Patna is moſt valued. The Indian Dyers call it *baleli*; it is alſo called *concome* in the regulations of M. Colbert. It is reduced to a very fine powder, and uſed pretty near the ſame way as the grain of Avignon, but in much leſs quantity, on account of its yielding a great deal of dye. It is ſomewhat better than the other yellow ingredients ſpoken of in the preceding chapter, but, as it is dear, it is a ſufficient reaſon for ſeldom or never uſing it in the leſſer dye..

It is ſometimes uſed in the great dye to gild the yellows made with weld, and to brighten and orange the ſcarlets; but this practice is to be condemned; for the air carries off all the colour of the turmeric in a ſhort time, ſo that the gilded yellows return to their firſt ſtate, and the ſcarlets brown conſiderably; when this happens to theſe ſort of colours, it may be looked on as certain that they have been falſified with this ingredient, which is not laſting.

I omit ſpeaking of ſaffron, which may alſo be made uſe of to dye yellow, but which I believe is not uſed; firſt, on account of its being dear; and ſecondly, becauſe its yellow is ſtill worſe than thoſe of the two preceding ingredients.

This is all that remains for me to ſay on the ingredients of the leſſer dye, they are only to be uſed for common and low-priced ſtuffs. It is not that I think it impoſſible to extract laſting colours from them, but then thoſe colours will not ſtrictly be

be the ſame which theſe ingredients yield naturally, or by the ordinary methods, as that gum and aſtriction which is wanting in them muſt be added, and then they are no more of the ſame quality; conſequently the rays of light will be differently reflected, and the colour will be different.

CHAP. XI.

Of SILVER GREY.

FOR pearl colour or ſilver grey, to dye forty pounds of woollen cloth or worſted, boil in a ſmall copper four pounds of logwood chips for half an hour, add to it ſix ounces of pearl-aſhes, and mix them well together; while this is performing, (having the worſted well ſcoured and parcelled in hanks on the dye-ſticks) heat a great copper with clean water, and put one peck of wheat bran in a bag into the copper; let it remain with often ſtirring about an hour; when the water begins to boil, put in three ounces of allum, which will throw the filth of the water to the top, when it muſt be taken off with the bowl; waſh the worſted in this liquor about forty minutes, when it muſt be taken up, and three or four pails of the logwood liquor added to the allum water. The goods muſt then be worked very quick for forty minutes, when you may add more logwood liquor if you ſee occaſion. Great care muſt be taken after waſhing to dry this colour in the ſhade, or it will perhaps change.

Some dye this colour in one liquor and boil the logwood in a bag. This proceſs is leſs tedious, but I prefer the former. It will be well for the Dyer to take notice, that if too great a quantity of allum

allum or aſhes are uſed herein, the colour will be imperfect; for the allum, if uſed in a right proportion, gives that bloom to the goods which is neceſſary for a pearl; if too much, the contrary would happen. The aſhes alſo, if uſed in too great quantity, would make the colour too red; this may ſeem a contradiction, becauſe the aſhes are an alkali, but practice will teach the truth.

Another excellent Silver Dye.

For twenty pounds weight of cloth or worſted, eight ounces of allum and twelve pounds of fenugreek muſt boil with the goods half an hour; then take it up, and add one pound of pearl-aſhes and eight ounces of Brazil wood; boil them gently with the goods half an hour; rinſe it and you have a beautiful colour.

INSTRUCTIONS
ON THE PROOF OF
DYED WOOL *and* WOOLLEN STUFFS.

AS it has been found that the methods preſcribed for the proof of dyes, by the thirty-ſeventh article of the French regulations for the Dyers in the good dye, of cloth, ſerges, and other woollen ſtuffs made in 1669, and by article 220 of the general inſtructions for the dying of wool of all colours, and for the culture of drugs and ingredients therein uſed made in 1671, were inſufficient for an exact judgment of the goodneſs or falſity of ſeveral colours, that they might ſometimes lead into error, and leave room for diſputes, different experiments have been made by the French king's order

order on wool designed for the manufacture of tapestry, to ascertain the degree of goodness of each colour, and the most convincing proofs of each.

For this purpose, fine wool was dyed in different colours both in the great and lesser dye, and exposed to the air and sun during a proper time; the good colours kept themselves perfectly, and the false ones were carried off more or less according to their bad quality; and as a colour is only to be accounted good inasmuch as it resists the action of the air and sun, this proof served as a rule to decide the goodness of different colours.

After this, several proofs were made on the same wool whose patterns had been exposed to the air and sun, and it was immediately found that the same trials could not be indifferently used in proving of all colours; for it often happened that one colour, known to be good by exposition to the air, was considerably changed by the essay proof, and that a false colour stood the same proof.

These experiments exploded lemon juice, vinegar, sour waters, and strong waters, as it was impossible to ascertain the degree of acidity of these liquors; and it appeared that the surest method is to use ingredients with common water, whose effects are always equal.

In following this plan, it has been judged necessary to divide into three classes all the colours in which wool is dyed, either in the great or lesser dye, and to fix the ingredients that are to be made use of in the essay proofs of the colours, comprehended in each of these three classes.

The colours comprehended in the first class are to undergo the proof of Roman allum, those of the second with white soap, and those of the third with red tartar.

But

But it is not ſufficient to be aſſured of the goodneſs of a colour by uſing in the proof ingredients whoſe effect may always be equal; it is alſo neceſſary, that not only the duration of this trial be exactly determined, but even the quantity of water fixed; for the proportion of water conſiderably augments or diminiſhes the activity of the ingredients which are put into it. The method of proceeding in theſe different proofs ſhall be ſet forth in the following articles:

ARTICLE I.

The Proof of Roman Allum muſt be made as follows:

One pound of water and half an ounce of allum are to be put in an earthen veſſel or pan. The veſſel is to be placed on the fire, and when the water boils ſtrongly, the wool is put in and left to boil for five minutes, after which it is to be taken out and waſhed in cold water; the weight of the pattern of wool muſt be a drachm or thereabouts.

II.

When ſeveral patterns are to undergo the proof together, the quantity of water and allum is to be doubled, or even trippled, which will no ways change the ſtrength or effect of the proof, if you obſerve the ſame proportion of water and allum, ſo that for each pound of water there may be one ounce of allum.

III.

To render the effect of the proof more certain, care muſt be taken not to try together wool of different colours.

IV.

IV.

The Proof with White Soap is to be made after the following Manner:

To one pound of water add two drachms of white ſoap, and place the veſſel on the fire; ſtir it with a ſtick that the ſoap may be thoroughly diſſolved; when it is ſo, and the water boils ſtrongly, the woollen pattern is put in, which is to boil for five minutes.

V.

When ſeveral patterns are to undergo this proof, the ſame method is to be obſerved as in the ſecond article, that is, to put to each pound of water two drachms of ſoap.

VI.

The proof with red tartar muſt be exactly the ſame, with the ſame proportions as the proof with allum, taking care that the tartar is finely powdered and well diſſolved in the water before the pattern is put in.

VII.

The following colours are to be proved with Roman allum, viz. crimſon of all ſhades, Venetian ſcarlet, flame colour or common ſcarlet, cherry colour and other ſhades of ſcarlet, violets and *gris-de-lin* of all ſhades, purples, lobſter, pomegranate, ſlate greys, lavender greys, violet greys, vinous greys, and all other like ſhades.

VIII.

If, contrary to the orders of the regulations on dying, any ingredients of the falſe dye have been made

made uſe of for fine wool dyed in crimſon, the cheat will be eaſily found out by the proof of allum, for it changes the fine crimſon a little on the violet, that is, makes it border a little on the *gris-de-lin*, but it deſtroys the higheſt ſhades of the baſtard crimſon; thus this proof is a ſure method to diſtinguiſh falſe crimſon from fine.

IX.

Scarlet of kermes or grain, commonly called Venetian ſcarlet, is no ways prejudiced by this proof; it raiſes the fire-colour ſcarlet to a purple, and gives a violet colour to the lighter ſhades, ſo that they border on the *gris-de-lin*, but it carries off the greateſt part of the falſe Brazil ſcarlet, and brings it to an onion-peel colour; it has yet a more ſenſible effect on the lighter ſhades of this falſe colour.

The ſame proof carries off almoſt entirely the ſcarlet of flock and its ſhade.

X.

Though the violet is not a ſimple colour, but formed of blue and red ſhades, it is nevertheleſs of ſo much conſequence as to merit a particular enquiry.

The ſame proof with Roman allum has ſcarcely any effect on the fine violet, whereas it conſiderably alters the falſe; but it muſt be obſerved, that it does not always equally carry off a great part of the ſhade of the falſe violet, becauſe this colour has ſometimes a ground of woad or indigo; now this ground being of the good dye, is not carried off by the proof, but the redneſs goes off, and the brown ſhades become almoſt blue, and the pale ones of the colour of lees of wine.

XI.

With regard to half fine violets, forbidden by the present regulations, they must be ranked in the class of false violets, and do not stand the proof.

XII.

The fine *gris-de-lin* may be known from the false by the same method, the difference is but trifling; the *gris-de-lin* of the good dye loses a little less than that of the false.

XIII.

Fine purples intirely resist the proof with allum, whereas the false intirely lose the greatest part of their colour.

XIV.

Lobster colours and pomegranate strike on the purple after the proof, if they have been made with cochineal, whereas they will pale greatly if fustic has been used; the use of which is prohibited.

XV.

Blues of the good dye will lose nothing in the proof, whether of woad or indigo; but those of the lesser dye will lose the greatest part of their colour.

XVI.

The slate greys, lavender greys, violet greys, and vinous greys, lose almost all their colour if they are of the false dye; whereas they perfectly maintain it, if of the good.

XVII.

The proofs of the following colours are to be made with white ſoap; yellow, jonquille or lemon colour, orange, and all the ſhades of yellow; all green ſhades from the yellow green or light green, to the cabbage or parrot green, the reds of madder, cinnamon, tobacco, and ſuch like.

XVIII.

This proof perfectly ſhews if the yellows and other ſhades derived from it are of a good or falſe dye; for it carries off the greateſt part of their colour if they have been made with grains of Avignon, roucou, turmeric, fuſtic, or ſaffron, whoſe uſe is prohibited for fine dyes, but it no ways impairs the yellows made with ſavory, Dyers wood, yellow wood, weld, or fenugreek.

XIX.

The ſame proof will alſo ſhew the goodneſs of greens, as thoſe of the falſe dye loſe moſt of their colour, or become blue if they have a ground of woad or indigo; whereas thoſe of the good dye loſe almoſt nothing of their ſhade, but remain green.

XX.

The reds of pure madder loſe nothing by the ſoap proof, on the contrary become finer, but if Brazil wood has been uſed, they loſe their colour in proportion to the quantity of it in the compoſition of the dye.

XXI.

Cinnamon, ſnuff colours, and others of this caſt, are ſcarcely altered by this proof, if of the

good dye, but they loſe conſiderably if roucou, fuſtic, or diſſolved flock has been made uſe of.

XXII.

The proof of allum would be of no uſe, and might even lead us into errors with regard to ſeveral colours belonging to this ſecond claſs, for it no ways alters the fuſtic nor the roucou, which nevertheleſs do not withſtand the action of the air; on the other hand, it carries off a great part of the ſavory and of the Dyers wood, which are very good yellows and greens.

XXIII.

All the brown or root colours ſhould undergo the proof with red tartar. The Dyers call by this name all colours that are not derived from the five primary colours; they are made with rinds and roots of walnut, alder-bark, ſumach or roudoul, ſantal and ſoot; each of theſe ingredients gives a great variety of ſhades, which are all comprehended under the general name of brown or root colour.

XXIV.

The above-named ingredients in the preceding article are good, except the ſantal and ſoot, which are not quite ſo good, and make the wool ſtiff when too great a quantity is uſed, ſo that all this proof can ſhew on theſe kind of colours, is, whether too much ſantal or ſoot has been put into them; in this caſe they loſe conſiderably by the proof with tartar; but if made with other ingredients, with only a moderate quantity of ſantal or ſoot, they ſtand a great deal better.

XXV.

XXV.

Black is the only colour which cannot be comprehended in any of the three classes above-mentioned, and a much more active proof must be made use of. To know if the wool has had a deep ground of blue, conformable to the regulations, the proof is to be made in the following manner: take a pint or pound of water, one ounce of tartar, and the same quantity of Roman allum well powdered; boil it, and then put in the pattern; let it boil strongly for a quarter of an hour, and afterwards wash it in cold water; you will then easily know if it has had the proper blue ground, for if so, the wool will remain of a dark blue almost black; if not, it will turn very grey.

XXVI.

It is common to brown certain colours with galls and copperas; this operation is called browning, which is to be permitted in the good dye; but as this may cause a particular effect in proving of these colours, it is to be observed that although the proof liquor appears loaded with dye as the browning is carried off, the wool must be reputed of a good dye if it still preserves its ground; if on the contrary it loses it, it is then deemed to be of the false dye.

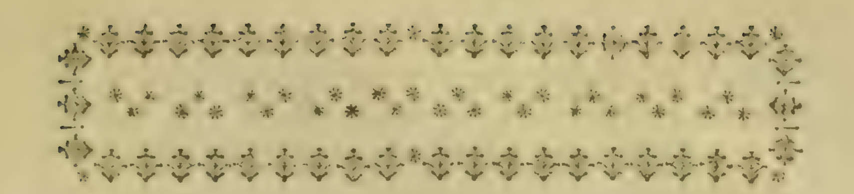
XXVII.

Although the browning, which is made of galls and copperas, if of the good dye, yet, as it hardens the wool, it is better to make use of the indigo or woad vat in preference.

XXVIII.

Common greys made with galls and copperas are not to undergo any of these proofs, because these colours are of the good dye, and are not otherways made; but it is to be observed, that they are first to be passed thro' the liquor of galls, and afterwards thro' a second liquor, containing the copperas, which must be much cooler than the first, for by this method they are made finer and more lasting.

THE



THE DYER's ASSISTANT.

PART III.

ADDITIONAL ARTICLES.

CHAP. I.

Of FLOWERS.

AMONG the infinite variety of colours which glow in the flowers of plants, there are very few which have any durability, or whofe fugitive beauty can be arrefted by art, fo as to be applied to any valuable purpofes. The only permanent ones are the yellow. The red, the blue, and all the intermediate fhades of purples, crimfons, violets, &c. are extremely perifhable. Many of thefe flowers lofe their colour on being barely dried; efpecially if they are dried flowly, as has been ufually directed, in a fhady and not warm place. The colours of all of them perifh, on keeping, even in the clofeft veffels. The more haftily they are dried, and the more perfectly they are fecured from

from the air, the longer they retain their beauty. The colouring matter, extracted and applied on certain bodies, is still more perishable: oftentimes it is changed or destroyed in the hands of the operator.

Of Blue Flowers.

The colour of many blue flowers is extracted by infusion in water, but there are some from which water gains only a reddish or a purplish hue. Of those that have been tried, there is not one which gives any blue tincture to spirituous liquors: some give no colour at all, and some a reddish one. The juice prest out from the fresh flowers is for the most part blue.

The blue juices and infusions are changed red by all acids; the marine acid seems to strike the most florid red. The flowers themselves, macerated in acid liquors, impart also a deep red tincture. Alkalis, both fixt and volatile, and lime water, change them to a green. Those infusions or juices, which have nothing of the native colour of the flower, suffer the same changes from the addition of acid and alkaline liquors; even when the flowers have been kept till their colour is lost, infusions made from them acquire still a red colour from the one, and a green from the other, though in a less degree than when the flowers were fresh.

The red colour produced by acids is scarcely more durable than the original blue; applied upon other bodies, and exposed to the air, it gradually degenerates into a faint purplish, and at length disappears, leaving hardly any stain behind. The green produced by alkalis changes to a yellow, which does not fade so soon. The green by lime water is more permanent and more beautiful.

Geeen

Green lakes, prepared from these flowers by lime water, have been used as pigments by the painter.

The flowers of cyanus have been greatly recommended, as affording elegant and durable blue pigments; but I have never been able to extract from them any blue colour at all. They retain their colour indeed, when hastily dried, longer than some other blue flowers, but they communicate nothing of it to any kind of menstruum. Infusions of them in watery, spirituous, and oily liquors, are all more or less of a reddish cast, without any tendency to blue. Allum, which is said to heighten and preserve their blue colour, changes it like that of other blue flowers, to a purplish red; acids to a deep red; alkalis and lime water to a green.

Solution of tin, added to the watery infusion, turns it to a fine crimson; on standing, a beautiful red fecula subsides, but it loses all its colour by the time it is dry. The watery infusion, inspissated to the consistence of an extract made with rectified spirit, is of a purplish colour. The colour of both extracts, spread thin and exposed to the air, quickly fades.

The flowers employed in these experiments were those of the common blue bottle of the corn-fields; *cyanus segetum C. B. centaurea calycibus serratis; foliolis linearibus integerrimis; infimis dentatis linn. spec.*

Red Flowers.

Red flowers readily communicate their own red colour to watery menstrua; among those that have been tried there is not one exception. Those of a full red colour, give to rectified spirit also a deep red tincture, brighter, though somewhat paler than the watery infusion; but the lighter red flowers, and

and thoſe that have a tendency to purpliſh, impart very little colour to ſpirit, and ſeem to partake more of the nature of the blue flowers than of the pure red.

Infuſions of red flowers are ſuppoſed to be heightened by acids, and turned green by alkalis, like thoſe of the blue; but this is far from being univerſal. Among thoſe I have examined, the roſe colours and purpliſh reds were all changed nearly in the ſame manner as the blues, but the full deep reds were not. The deep infuſion of red poppies is turned by alkalis, not to a green but to a duſky purple.

Yellow Flowers.

The colours of yellow flowers, whether pale or deep, are in general durable. Many of them are as much ſo perhaps as any of the native colours of vegetables. The colour is extracted both by water and by ſpirit; the watery infuſions are the deepeſt. Neither acids nor alkalis alter the ſpecies of colour, though both of them vary its ſhades; acids rendering it paler, and alkalis deeper: allum likewiſe conſiderably heightens it, though not ſo much as alkalis.

Wool or ſilk, impregnated with a ſolution of allum and tartar, receives, on being boiled with the watery infuſion, or decoction, a durable yellow dye, more or leſs deep according as the liquor is more or leſs ſaturated with the colouring matter.

An infuſion of the flowers made in alkaline ley, precipitated by allum, gives a durable yellow lake. Some of theſe flowers, particularly thoſe of the chryſanthemum, or corn-marigold, appear (from the *Ars Tinctora Fundamentalis*, publiſhed by *Stahl*) to be made uſe of by the German Dyers.

In

In ſome of the deep reddiſh yellow, or orange-coloured flowers, the yellow matter ſeems to be of the ſame kind with that of the pure yellow flowers, but the red to be of a different kind from the pure red ones: watery menſtrua take up only the yellow and leave the red, which may afterwards be extracted by rectified ſpirit of wine, or by water actuated with fixed alkaline ſalt. Such particularly are the ſaffron-coloured flowers of carthamus. These, after the yellow matter has been extracted by water, are ſaid to give a red tincture to ley: from which, on ſtanding at reſt for ſome time, a deep bright red fecula ſubſides, called, from one of the names of the plant which produces it, ſafflower, and from the countries whence it is commonly brought to us, Spaniſh red, and China lake. this pigment impregnates ſpirits of wine with a beautiful red tincture, but communicates no colour to water.

I have endeavoured to ſeparate by the ſame treatment, the red matter of ſome of the other reddiſh yellow flowers, as thoſe of the garden marigold, but without ſucceſs. Plain water extracted a yellow colour, and alkaline ley extracted afterwards only a paler yellow; though the digeſtions were continued till the flowers had loſt their colour, the tinctures were no other than yellow, and not ſo deep as thoſe obtained from the pure yellow flowers.

The little yellow floſculi, which in ſome kinds of flowers are collected into a compact round diſc, as in the daiſy and corn-marigold, agree ſo far as they have been examined with the expanded yellow petala. Their colour is affected in the ſame manner by acids, by alkalis, and by allum, and equally extracted by water and by ſpirit.

But

But the yellow farina or fine dust lodged on the tips of the stamina of flowers, appears to be of a different kind. It gives a fine bright yellow to spirit, and a duller yellow to water; the undissolved part proving, in both cases, of a pale yellowish white. Both the watery and spirituous tinctures were brightened by alkaline liquors, turned red by acids, and again a deep yellow on adding more of the alkali. I know no other vegetable yellow that is changed red by acids.

White Flowers.

White flowers are by no means destitute of colouring matter. Alkaline lixivia extract from some of them a green tincture, and change their colourless expressed juices to the same colour. But I have not observed that they are turned red by acids. The flowers of the common wild convolvulus or bind-weed, which in all their parts are white, give a deep yellow or orange tincture to plain water, which, like the tinctures of flowers which are naturally of that colour, is rendered paler by acids, heightened a little by allum, and more considerably by alkaline salts. The vapours of the volatile vitriolic acid, or of burning sulphur, which whiten or destroy the colour of the coloured flowers, make no change in the white.

CHAP. II.

Of FRUITS.

THE red juices of fruits, as red currants, mulberries, elder berries, and Morello and black cherries, &c. gently inspissated to dryness, dissolve

diſſolve again almoſt totally in water, and appear nearly of the ſame red colour as at firſt. Rectified ſpirit extracts the tinging particles, leaving a conſiderable portion of mucilaginous matter undiſſolved: and hence the ſpirituous tincture proves of a brighter colour than the watery. The red ſolutions and the juices themſelves are ſometimes made dull, and ſometimes more florid, by acids, and generally turned purpliſh by alkalis.

The colours of theſe juices are for the moſt part periſhable. They reſiſt indeed the power of fermentation, and continue almoſt unchanged after the liquor has been converted into wine. But when the juice is ſpread thinly on other bodies, exſiccated, and expoſed to the air, the colour quickly alters and decays: the bright lively reds change the ſooneſt. The dark, dull red ſtain from the juice of the black-cherry, is of conſiderable durability. The fruit of the American opuntia, or prickly pear, the plant upon which the cochineal inſect is produced, is perhaps an exception: this bright red fruit, according to *Labat*, gives a beautiful red dye. Some experiments, however, made upon the juice of that fruit, as brought into England, did not ſeem to promiſe any great advantage from it; but the particulars I cannot now recollect.

The ripe berries of buckthorn ſtain paper of a green colour. From theſe is prepared the ſubſtance called ſap-green, a pigment ſufficiently durable, readily ſoluble in water, but not miſcible with oil. The berries dried whilſt green, and macerated in allum-water, are ſaid to yield a yellow pigment; and when they have grown over-ripe, ſo as to fall off ſpontaneouſly, a purple one. Woollen cloth, prepared with allum and tartar, receives, on being boiled with the berries, a periſhable yellow dye. The French berries, or grained Avignon of the

French Dyers, one of the moſt falſe, that is, the moſt periſhable of the yellow dyes, is the berry of a ſpecies of buckthorn ſmaller than that which grows wild among us.

It is ſaid that the berry of the *Heliotropium tricoccum*, which grows wild about *Montpelier*, ſtains paper of a green colour, and that this green turns preſently to a blue: that the common blue paper receives its colour from this juice: and that the red rags, called *turnſol*, employed for colouring wines and other liquors, are tinctured by the ſame juice, turned red by acids. According to M. *Niſſolle* of the French academy of ſciences (as quoted by Savary in his *Dictionaire de Commerce*) the colouring juice is obtained, not from the berries, but from the tops of the plant, gathered in Auguſt, ground in mills, and then committed to the preſs. The juice is expoſed to the ſun about an hour, the rags dipped in it, dried in the ſun, moiſtened by the vapour which ariſes during the ſlacking of quick-lime with urine, then dried again in the ſun, and dipped again in the juice. The Dutch and others are ſaid to prepare turnſol rags, and turnſol in the maſs, from different ingredients, among which archil is a principal one.

In ſome plants, peony for inſtance, the ſeeds at a certain point of maturity are covered with a fine ſhining red membrane: the pellicles of the ſeeds of a certain American tree afford the red maſſes brought inte Europe under the names of annotto, orlean, and roucou. The red ſeeds, cleared from the pods, are ſteeped in water for ſeven or eight days or longer, till the liquor begins to ferment; then ſtrongly ſtirred, and ſtamped with wooden paddles and beaters, to promote the ſeparation of the red ſkins: this proceſs is repeated ſeveral times till the ſeeds are left white. The liquor paſſed through

through close cane sieves is pretty thick, of a deep red colour, and a very ill smell. In boiling it throws up its colouring matter to the surface in form of scum, which is afterwards boiled down by itself to a due consistence, and made up, while soft, into balls.

The annotto commonly met with among us, is moderately hard and dry, of a brown colour on the outside, and a dull red within. It is with difficulty acted on by water, and tinges the liquor only of a pale brownish yellow colour. In rectified spirit of wine it readily dissolves, and communicates a high orange or yellowish red. Hence it is used as an ingredient in varnishes, for giving more or less of an orange cast to the simple yellows. Alkaline salts render it perfectly soluble in boiling water, without altering its colour. Wool or silk boiled in the solution, acquire a deep but not a very durable orange dye. Its colour is not changed by allum or by acids any more than by alkalis; but when imbibed in cloth, it is discharged by soap, and destroyed by exposure to the air.

Mr. Pott, in the Berlin Memoirs for the year 1752, mentions a very extraordinary property of this concrete. "With the vitriolic acid, it pro-"duces a blue colour, of extreme beauty, but with "this capital defect, that all salts and liquors, "even common water, destroy it." The specimen of annotto which I examined, was not sensibly acted on by spirit of vitriol. It received no change in its own colour, and communicated none to the liquor. Nor did any visible change ensue upon dropping the acid into tinctures of annotto made in water or in spirit.

Labat informs us, that the Indians prepare an annotto greatly superior to that which is brought to us, of a bright shining red colour, almost equal

to carmine; that for this purpoſe, inſtead of ſteeping and fermenting the ſeeds in water, they rub them with the hands previouſly dipt in oil, till the pellicles come off, and are reduced into a clear paſte, which is ſcraped off from the hands with a knife, and laid on a clean leaf in the ſhade to dry. *De Laet*, in his notes on Marcgrave's Natural Hiſtory of Brazil, mentions alſo two kinds of annotto, one of a permanent crimſon colour, (coccineus) uſed as a fucus; and another which gives a colour inclining more to that of ſaffron. This laſt, which is our annotto, he ſuppoſes to be a mixture of the firſt ſort with certain rezinous matters, and with the juice of the root of the tree.

Ximenes relates, that annotto with urine ſtains linen of ſuch a permanent colour that it can never be waſhed out. Perhaps the firſt ſort is meant. Our annotto, boiled in urine, imparted to linen a deep yellowiſh red: the ſtained linen, hung out in the air in ſummer, in ſeven or eight days loſt all its colour and became white again.

CHAP. III.

Of LEAVES.

THE green colour of the leaves of plants is extracted by rectified ſpirit of wine and by oils. The ſpirituous tinctures are generally of a fine deep green, even when the leaves themſelves are dull coloured, or yellowiſh, or heary. The colour however ſeldom abides long even in the liquor; much leſs when the tinging matter is ſeparated in a ſolid form, and expoſed with a large ſurface to the air. The editor of the *Wirtemberg Pharmacopœia* obſerves, that the leaves of acanthus, brankurſine

brankurfine or bears-breech, give a more durable green tincture to fpirit than thofe of any other herb. Alkalis heighten the colour both of the tinctures and green juices. Acids weaken, deftroy, or change it to a brownifh. Lime water improves both the colour and the durability. By means of lime, not inelegant green lakes are procurable from the leaves of acanthus, lilly of the valley, and feveral other plants.

There are very few herbs which communicate any fhare of their green colour to water; perhaps none that give a green of any confiderable deepnefs. It is faid, however, that the leaves of fome plants give a green dye to woollen, without the addition of any other colouring matter; particularly thofe of the wild chervil or cow-weed (*Myrrhis fylveftris feminibus lævibus, C. B.*) the common ragwort, and devil's bit. The procefs with this laft, as defcribed by *Linnæus* (in the *Svenfca Acad. Handle. ärs*, 1742) is pretty remarkable. The peafants, he informs us, in fome of the Swedifh provinces, ftratify the frefh leaves with woollen yarn, and boil them about as long as it is cuftomary to boil fifh.

The whole is fuffered to ftand in the veffel for a night. The wool, taken out in the morning, does not appear to have received any colour. The pot is again made hot, and the yarn hung over it upon a ftick, covered with an inverted difh to confine the fteam, for this fteam is fuppofed to be effential to the colour. The yarn is afterwards wrung, the leaves taken out of the boiling liquor, a little frefh water added to the decoction, and the wool frequently dipt therein, till it appears fufficiently coloured.

The leaves of many kinds of herbs and trees give a yellow dye to wool or woollen cloth that has

been previously boiled with a solution of allum and tartar; weld in particular affords a fine yellow, and is commonly made use of for this purpose by the Dyers, and cultivated in large quantities in some parts of England. There is no colour for which we have such plenty of materials as for yellow. Mr. Hellot observes in his *Art de Teindre*, that all leaves, barks, and roots which on being chewed discover a slight astringency, as the leaves of the almond, peach and pear-trees, ash-bark, (especially that taken off after the first rising of the sap in spring) the roots of wild patience, &c. yield durable yellows more or less beautiful according to the length of time that the boiling is continued, and the proportions of allum and tartar in the preparatory liquor: that a large quantity of allum makes these yellows approach to the elegant yellow of weld: that if the tartar is made to prevail, it inclines them to an orange: that if the roots, barks, or leaves be too long boiled, the yellow proves tarnished, and acquires shades of brown: that for dying with weld, the best proportions of the salts are, four parts of allum and one of tartar to sixteen of the wool; and that the wool prepared with these is to be boiled again with five or six times its quantity of weld: that for light shades, it is customary to diminish the allum and omit the tartar; and that in this case the colour is more slowly imbibed, and proves less durable.

Of all the colours of the Dyer, we have the fewest materials for blue; the mineral and animal kingdoms afford none, excepting perhaps Prussian blue, which Mr. Macquer has lately attempted to introduce into this art. The vegetable yields but two, which are both produced from the leaves of plants, indigo and woad.

CHAP.

C H A P. IV.

Mr. LEWIS's HISTORY *of* MADDER, *and Manner of treating it.*

MADDER (*Rubia tinctorum sativa, C. B.*) is one of the asperifolious stellated plants, or of those which have rough narrow leaves, set in form of a star at the joints of the stalks. The root, which is the only part made use of, is long and slender, of a red colour both on the outside and within, excepting a whitish pith which runs along the middle.

This plant was formerly cultivated among us in great quantity for the use of the Dyers, who for some time past have been supplied from Holland and Zealand. Its culture is now again set on foot in this kingdom, under the laudable encouragement of a public society. Madder is not like alkanet, and other exotic plants, the colour of which degenerates in our climates, for English madder is equal to the best that is brought from abroad.

Madder root gives out its colour both to water and to rectified spirit; the watery tincture is of a dark dull red, the spirituous of a deep bright one. Taken internally (for it has sometimes been used medicinally as an aperient and diuretic) it tinges the urine red. In the Philosophical Transactions, and in the Memoirs of the French Academy, there are accounts of its producing a like effect upon the bones of animals, to whom it had been given with their food. All the bones, particularly the more solid ones, were changed both externally and internally to a deep red, but neither the cartilaginous nor fleshy part suffered any alteration. Some of these bones, macerated in water for many weeks together,

together, and afterwards ſteeped and boiled in ſpirit of wine, loſt nothing of their colour, nor communicated any tinge to the liquors.

The dealers in this commodity make three ſorts of it; madder in the branch, madder in the bunch or in the bundle, and madder unbundled.

Madder in the branch is the entire root dried. This ground in mills to a groſs powder is the unbundled madder. The bundled or bunch madder is a powder of the finer roots, freed from the outer bark and from the pith. It is ſaid that by keeping for two or three years in cloſe caſks the colour is improved; in open veſſels it decays.

Madder imparts to woollen cloth, prepared with allum and tartar, a very durable, though not a very beautiful red dye. As it is the cheapeſt of all the red drugs that give a durable colour, it is the principal one commonly made uſe of for ordinary ſtuffs. Sometimes its dye is heightened by the addition of Brazil wood; and ſometimes it is employed in conjunction with the dearer reds, as cochineal, for demi-ſcarlets and demi-crimſons. Mr. Hellot informs us, that thoſe who dye the beſt madder reds are particularly careful to keep the liquor of a heat conſiderably below boiling, increaſing the fire only towards the end, ſo as to make it boil for a minute or two juſt before the cloth is taken out to confirm the dye; a boiling heat enables water to extract not only the red, but a tawny or browniſh matter, which debaſes the red to a dull brick colour.

The proportion of madder is about half the weight of the cloth. The beſt proportion of ſalts for preparing the cloth to receive the dye ſeems to be five parts of allum and one of red tartar for ſixteen of the ſtuff; which is to be boiled with theſe for two hours or longer, then kept moiſt for

ſome

ſome days, and afterwards digeſted with the madder.

A variation in the proportion of the ſalts, varies the colour communicated by the madder, and not only the ſhade, but the ſpecies of colour.

If the allum be diminiſhed, and the tartar increaſed, the dye proves a red cinnamon; if the allum be entirely ommitted, the red is deſtroyed, and a very durable tawny cinnamon is produced.

On boiling the dyed cloth in weak alkaline ley, great part of the colour is deſtroyed, and the remainder appears of a dirty or a kind of ſallow hue. Solution of ſoap, on the other hand, diſcharges a part, and leaves the remaining red more lively than before.

Volatile alkalis heighten the red colour of madder, but at the ſame time render it fugitive like themſelves. Madder prepared with lime and urine, after the manner practiſed for archil, loſt its red colour on attempting to dye with it, and communicated to the cloth only permanent nut-colours.

If a pure red, as that of cochineal, be applied on cloth which has been previouſly dyed blue, and afterwards prepared for receiving this red by boiling with allum and tartar, a purple or violet will be produced, according as the blue or the red prevail. The madder red has not this effect, for as its colour is not a pure red, but is tarniſhed by the tawny matter which its woody fibres have in common with other roots, it gives upon blue only a cheſnut dye, more or leſs deep according to the deepneſs of the blue applied firſt.

There are, however, means of obtaining from madder a fine purple, without the addition of any other colouring drug. A piece of white woollen cloth, weighing half an ounce, was boiled for half an hour with ten grains of Roman allum and ſix grains

grains of cryſtals of tartar, and then taken out, ſqueezed, and ſuffered to cool. Twenty-four grains of bunch madder were added to the ſame liquor; and after the madder had given out its colour, twenty drops of a ſolution of biſmuth (made in ſpirit of nitre, diluted with equal its weight of water) were dropped in. The cloth was now dipped again, and in half an hour taken out, ſqueezed, and waſhed. It appeared of a crimſon colour, nearly as beautiful as if it had been dyed with cochineal. To try the effect of loading it further with the colouring matter, it was returned into the liquor and boiled for a quarter of an hour longer: it had now acquired a purple colour ſufficiently vivid.

On varying this experiment by keeping the cloth moiſt for ſome days after the preparation with allum and tartar, then dipping it in a plain decoction of madder made as uſual without ſalts, and adding, when it had gained a bright cinnamon colour, the ſame ſolution of biſmuth, the dye inſtead of purple proved only a cheſnut.

CHAP. V.

Of FUSTIC.

FUSTIC is the wood of ſpecies of mulberry-tree, growing in Jamaica and Brazil, called by *Sir Hans Sloane*, *Morus Fructu Viridi Ligno Sulphureo Tinctorio*. It is of a deep ſulphur yellow colour, which it readily gives out both to water and ſpirit. The watery decoction dyes prepared woollen of a very durable orange yellow: the colour is imbibed by the cloth in a moderate warmth without boiling.

The

The fustet or fustel of the French is a yellow wood or root very different from our fustic. It gives a fine orange dye to woollen, but the colour is extremely perishable in the air. The plant grows wild in Italy and Provence, and is cultivated with us in gardens on account of the beauty of its flowers. It is called *Venice sumach*, *cotinus cotiaria*, *coccigria*; *cotinus matthioli*, *C. B.*

C H A P. VI.

NEPHRITIC WOOD.

THIS wood is brought from the eastern countries in large pieces, covered with a dark blackish bark. The wood is hard, heavy, compact, of a fine grain, of a whitish or pale yellow colour on the outside, and a dusky reddish brown in the heart. Of the tree we have no very certain account.

This wood, particularly the outer pale part, gives out both to water and to rectified spirit a deep tincture appearing, when placed between the eye and the light, of a golden colour; in other situations, blue. Hence it is named by *Caspar Bauhine*, *lignum peregrinum, aquam cœruleam redden*.

By this mark it is easily distinguished from pieces of a different kind of wood, which are sometimes mixt with it, and which give only a yellow tincture to water.

It is remarkable, that the blue colour of the infusion of nephritic wood is destroyed by acids, the liquor after the admixture of these appearing in all situations yellow; and that the addition of alkalis, either of the fixt or volatile kind, in quantity sufficient to neutralize the acid, restores the blueness.

No

No other woody matter is known that gives any degree of blue tincture, and no other vegetable blue is known that is thus destructible by acids.

This wood is at present rarely met with in the shops; nor is it applied to any use, except that some have employed it medicinally, and expected from it *diuretic virtues*, whence its name *nephritic wood*.

C H A P. VII.

Mr. FERGUSON's *History of* LOGWOOD *as a Colouring* DRUG.

LOGWOOD or Campeachy-wood (*Lignum Brazilo-simile, cœruleo tingens, J. B.*) is the wood of a low prickly tree, which grows plentifully about Campeachy or the Bay of Honduras, and has of late been introduced into some of the warmer of the British plantations, particularly Jamaica. It is a native of low marshy places. The wood comes over in pretty large logs, cleared from the bark. It is very hard, compact, heavy, and of a red colour.

Logwood gives out its colour both to watery and spirituous menstrua, but not readily to either. It requires to be rasped and ground into fine powder, and boiled in several fresh parcels of the liquors. Rectified spirit extracts the colour more easily, and from a larger proportion of the wood than water does.

The tinctures both in water and in spirit are of a fine red, with an admixture, particularly in the watery one, of a violet or purple. Volatile alkaline salts or spirits incline the colour more to purple.

The

The vegetable and nitrous acids render it pale, the vitriolic and marine acids deepen it.

The watery decoction, wrote with on paper, loses its redness in a few days and becomes wholly violet. This colour it communicates also to woollen cloth previously prepared by boiling with a solution of allum and tartar. The dye is beautiful, but very perishable. It is often used by the Dyers as an ingredient in compound colours, for procuring certain shades which are not easily hit by other materials.

With chalybeate solutions it strikes a black. Hence it is employed in conjunction with those liquors for staining wood black for picture frames, &c. and with the addition of galls for dying cloth and hats black. The black dyes in which this wood is an ingredient, have a particular lustre and softness, far beyond those made with vitriol and galls alone. The beauty however which it here imparts is not permanent, any more than its own natural violet dye.

On the same principle it improves also the lustre and blackness of writing-ink. Ink made with vitriol and galls does not attain to its full blackness, till after it has lain some time upon the paper. A due addition of logwood renders it of a deep black as it flows from the pen, especially when vinegar or white wine is used for the menstruum.

Decoctions and extracts made from logwood have an agreeable sweetish taste, followed by a slight astringency. They have lately been introduced into medicine, and given with success in cases where mild restringents are required. They often tinge the stools, and sometimes the urine of a red colour.

CHAP. VIII.

The Process of PRUSSIAN BLUE.

PRUSSIAN blue is prepared by precipitating a solution of green vitriol and allum with a lixivium drawn from fixed alkaline salt that has been calcined with animal coals. Commonly about three parts of alkali and two of dried ox-blood are calcined so long as any flame appears, then thrown into boiling water, and the strained decoction poured into a hot mixture of solutions of four parts of allum and one or less of vitriol. The liquor becomes instantly thick or curdly, and looks at first of a greyish colour, which changes to a brown, and in a little time to a bluish green. The matter being well stirred together, and mixed with a quantity of hard spring water, a green precipitate subsides: spirit of salt poured upon the edulcorated powder dissolves a part, and leaves the rest blue.

Mr. Geoffrey is the first who has given any plausible theory of this process, or any rational means for improving it. He observes, that the Prussian blue is no other than the iron of the vitriol, revived by the inflammable matter of the alkaline lixivium, and perhaps brightened by an admixture of the white earth of allum; that the green colour proceeds from a part of the yellow ferrugineous calx or oker unrevived, mixing with the blue, and that the spirit of salt dissolves this oker more readily than the blue part, though it will dissolve that also by long standing, or if used in too large quantity. From these principles he was led to increase the quantity of inflammable matter, that there might be enough to receive the whole of the ferrugineous oker, and produce a blue colour at once without the use of the acid spirit. In this he perfectly

perfectly ſucceeded, and found at the ſame time that the colour might be rendered of any degree of deepneſs or lightneſs at pleaſure.

If the alkali is calcined with twice its weight of dried blood, and the lixivium obtained from it, poured into a ſolution of one part of vitriol, to ſix of allum, the liquor acquires a very pale blue colour, and depoſits as pale a precipitate. On adding more and more of a freſh ſolution of vitriol, the colour becomes deeper and deeper almoſt to blackneſs. He imagines, with great probability, that the blue pigment thus prepared will prove more durable in the air, mingle more perfectly with other colours, and be leſs apt to injure the luſtre of ſuch as are mixed with, or applied in its neighbourhood, than that made in the common manner; the tarniſh and other inconveniences to which the common Pruſſian blue is ſubject, ſeeming to proceed from the acid and ſpirit, which cannot be totally ſeparated by any ablution.

He takes notice alſo of an amuſing phænomenon which happens upon mixture. When the liquors are well ſtirred together, and the circular motion as ſoon as poſſible ſtopt; ſome drops of ſolution of vitriol (depurated by long ſettling) let fall on different parts of the ſurface, divide, ſpread, and form curious repreſentations of flowers, trees, ſhrubs, flying inſects, &c. in great regularity and perfection. Theſe continue ten or twelve minutes, and on ſtirring the liquor again, and dropping in ſome more of the ſolution of vitriol, are ſucceeded by a new picture.

Mr. Macquer has ingeniouſly applied the preparation of this pigment to the dying of wool and ſilk, and found means of fixing the blue fecula in their pores. By dipping cloth firſt in a diluted ſolution of vitriol and allum, then in the ley diluted, and afterwards in water acidulated with

ſpirit of vitriol, it acquires a light blue colour, which becomes deeper and deeper on repeating the dippings alternately in the ſame order as before; adding to the liquors each time a little more of the reſpective ſaline matters. The blue dye, he ſays, in beauty and luſtre exceeds that of indigo and woad, as far as ſcarlet does the madder red, and penetrates the whole ſubſtance of fulled cloth without weakening it. The colour is durable in the air, and ſtands boiling with allum water, but is diſcharged by ſoap, and, without certain precautions, liable to be ſpecky or unequal. See the Memoirs of the French Academy for the year 1749.

C H A P. IX.

ALKANET-ROOT.

THE roots of alkanet in many reſpects very much reſemble ſaunders wood, but differ from it remarkably in others. They impart an elegant deep red to pure ſpirit of wine, to oils, to wax, and to unctuous ſubſtances: I do not know of any red drug that tinges oil of ſo fine a colour. To water they give only a dull browniſh red. The ſpirituous liquor, on being inſpiſſated to the conſiſtence of an extract, inſtead of preſerving its fine red like that of ſaunders, changes to an unſightly brown.

Volatile ſpirits have been ſaid to gain from this root a beautiful violet or amethyſt colour; but I have not found that they extract any colour but a dull reddiſh brown.

The alkanet plant is a ſpecies of bugloſs, named by Tournefort, *bugloſſum radice rubra, ſive anchuſa vulgatior floribus cæruleis*. It is a native of the warmer parts of Europe, and cultivated in ſome of our

our gardens. The greateſt quantities are raiſed in Germany and France, particularly about Montpelier, from whence we are chiefly ſupplied with the roots.

The alkanet root produced in England is much inferior in colour to that brought from abroad; the former being only lightly reddiſh, the latter of a deep purpliſh red. This has induced ſome to ſuſpect that the foreign roots owe part of their colour to art, but a chymical examination teaches otherwiſe. The colouring matter is found, upon experiment, to be of the ſame kind in both, and to differ in ſeveral of its properties from that of all the other known red drugs; ſo that no artifice appears to be practicable without diſcovery, unleſs it was concentrating the colour of two roots into one, or ſuperſaturating one root with the colour extracted from another.

The principal uſe of alkanet root is for colourings oils, unguents, lip-ſalves, plaiſters, &c. Wax tinged with it, applied on warm marble, ſtains it of a fleſh colour, which ſinks deep into the ſtone. The ſpirituous tincture gives a deep red ſtain.

The colour of this root is confined to the cortical part, the pith being whitiſh; hence as the ſmall roots have more bark in proportion to their bulk than the large ones, thoſe alſo contain moſt colour.

CHAP. X.

Of ALLUM.

NATURE produces no perfect allum, but affords the materials for it in ſundry ores, pyritæ, ſtones, ſlates, earths, waters, and bitumens,

as pit-coal. Some late experiments by Mr. Geoffrey and Mr. Pot have ſhewn that the earth of allum is contained in clay, and that a true allum may be prepared by digeſting clay in the vitriolic acid. Both theſe gentlemen imagine that only a particular part of the clay is here extracted.

Whether it exiſted originally in the clay, poſſeſſed of the ſame properties which it is found to have when extracted, or whether it has ſuffered a change in the operation, they have not determined. From the experiments I have made, the latter ſeems to be the caſe. Powdered tobacco-pipe-clay, being boiled in a conſiderable quantity of oil of vitriol, and the fire continued to dryneſs, the matter, examined when grown cold, diſcovers ſcarcely any taſte, or only a ſlight acidulous one. On expoſure to the air for a few days, the greateſt part of it is found changed into lanuginous efflorеſcences in taſte exactly like allum: the remainder treated with freſh oil of vitriol in the ſame manner, exhibits the ſame phænomena, and this repeatedly, till nearly the whole of the clay is converted into an aſtringent ſalt.

If the earth be ſeparated again from the acid, (by diſſolving the ſalt in water, and precipitating with any alkaline ſalt) it is now found to diſſolve with eaſe in every acid; to form with the vitriolic allum again; with the nitrous, a compound reſembling allum in taſte; with the vegetable acids, a ſubſtance leſs aſtringent and leſs ungrateful.

CHAP.

CHAP. XI.

Chymical History of SAUNDERS, *and its Difference from other* RED-WOODS.

RED ſaunders is a hard, compact, ponderous wood, of a dark blackiſh red on the outſide, and a light red colour within; of no particular ſmell or taſte. It is brought from the Coromandel coaſt and from Golconda. Of the tree we have no certain account. Its principal uſe is as a colouring drug. Thoſe whoſe buſineſs it is to raſp and grind it into powder, probably employ certain ſaline or other additions to improve the colour; whence the remarkable differences in the colour of powdered ſaunders prepared in different places. That of Straſburgh is of the deepeſt and livelieſt red. Some ſorts are of a dead dark red, and ſome of a pale brick red; ſome incline to purple or violet, and ſome to brown.

The colour of this wood reſides wholly in its reſin, and hence is extracted by rectified ſpirit, whilſt water, though it takes up a portion of mucilaginous matter, gains no tinge, or only a ſlight yellowiſh one. From two ounces of the wood were obtained by ſpirit of wine three drachms and a half of reſinous extract, and afterwards by water, a ſcruple of mucilage. By applying water at firſt, I obtained from two ounces two drachms and ſix grains of a tough mucilaginous extract, which could not eaſily be reduced to dryneſs. The remainder ſtill yielded, with ſpirit, two drachms of reſin. The indiſſoluble matter weighed, in the firſt caſe, an ounce and a half and fifteen grains; in the latter, nineteen grains leſs. Neither the diſtilled

diſtilled water nor ſpirit had any remarkable taſte or ſmell.

The red colour of ſaunders appears to be no other than a concentrated yellow, for by bare dilution it becomes yellow. A grain of the reſinous extract, diſſolved in an ounce of rectified ſpirit, tinges it red, but this ſolution, mixt with a quart of freſh ſpirit, gives only a yellow hue. Hoffman reports that this reſin does not give a tincture to any kind of oil. I have tried five oils, thoſe of amber, turpentine, almonds, anniſeeds and lavender. It gave no colour to the two firſt, but a deep red to the laſt, and a paler red to the other two.

CHAP. XII.

Of VERDIGRISE.

IT may not be amiſs to give the reader a chymical hint of verdigriſe.

Vegetable acids diſſolve copper ſlowly, but in conſiderable quantity; the ſolution ſhoots into bluiſh green chryſtals, ſimilar to the verdigriſe, *ærugo* or *viride æris*, of the ſhops. This preparation is made in large quantities in France, particularly about Monpelier, by ſtratifying copper-plates with the huſks of grapes remaining after the juice has been preſt out. Theſe ſoon become acid, and corrode the copper.

Verdigriſe ſhould be choſen in cakes, not moiſt or unctuous, but dry, compact, and of an uniform texture, of a lively green colour throughout, as free as poſſible from white and black ſpecks, and ſeeds or ſtalks of the grape. It is purified by ſolution in diſtilled vinegar, and chryſtallization, and then called, improperly, diſtilled verdigriſe or flowers

flowers of copper. The Dutch who prepare these chryſtals in large quantities, after duly evaporating the ſolution, ſet it to ſhoot, not, as is cuſtomary, in a cold but in a warm place, as practiſed in making ſugar-candy.

If rectified ſpirit of wine be added to the ſolution, or if volatile alkalis be added to a ſolution of copper and ſpirit of wine to this mixture, ſmall blue chryſtals will be immediately formed. Theſe are called by ſome antepileptic chryſtals of copper.

Highly rectified ſpirit of wine, digeſted on half an ounce or twelve ſcruples of powdered verdigriſe, diſſolved three ſcruples and a half; ordinary rectified ſpirit, four ſcruples; common malt ſpirits, four and a half, and French brandy ſeven and a half. Water diſſolved, out of the ſame quantity, five ſcruples. Common wine vinegar diſſolved all but fifteen grains, and diſtilled vinegar, all but ten grains. The whole quantity of verdigriſe diſſolved in either kind of vinegar, could not be recovered again in a chryſtalline form.

From the common vinegar only two ſcruples and five grains chryſtallized, and from the diſtilled vinegar three ſcruples. The reſiduum in the firſt caſe continued ſoftiſh, in the latter dry. With French brandy there was no chryſtallization at all; the whole that the ſpirit had taken up remaining uniformly mixt into the conſiſtence of an extract.

A HINT



A

HINT

TO THE

DYERS

AND

CLOTH-MAKERS.

AND WELL WORTH THE NOTICE OF

THE MERCHANT.

By JAMES HAIGH,

Late SILK and MUSLIN-DYER, LEEDS.



PREFACE.

THE AUTHOR of the DYER'S ASSISTANT thinks it his duty, in gratitude to the professors in that noble art, to subscribe his hearty thanks for their approbation of, and encouragement given to that work, in this and every part of England. It is well known my design is not to teach strangers to dye; but to help the thinking part of the Dyers to improve; and to shew them how I spend some of my leisure hours to help them, as well as myself, to a most necessary knowledge. It is well known by that body of people, and felt too by some, that the price for dying woollen goods hath been much reduced of late. Many circumstences having determined me, long since, to acquire all possible knowledge in the practice of dying, I am therefore constrained once more to recommend a strict inquiry into the original quality of all the drugs they use, that thereby, if possible, they may discover some of the many hidden advantages that may justly be expected therefrom.

I am astonished that no artist has ever attempted to improve this most ingenious art on chymical principles. I begun the work in hopes that my master-piece would undertake to improve it, but in vain do I expect it.

A Word to the thinking Part of Dyers.

If you were ſenſible of the double advantage that might be acquired in the uſe of many of your vegetable drugs, which muſt be firſt grounded on chymical experiments in miniature, which will be a certain rule to the practice at large, I am certain you would not reſt till you had made ſome improvement.

If after you have been dying with that reſenous drug, ſaunders, when emptying the veſſel you take up a handful, dry it and digeſt it in a phial with ſome pure ſpirits of wine, and it will afford you an excellent red, water being inſufficient to diſſolve the reſin, and let out the prime part of the colour. Many others may be diſcovered if an unwearied attention was paid.

Many will cenſure and deſpiſe this, for no other reaſon than becauſe they cannot ſee into it; nor will they be at any pains to learn and improve their talents. They ſeem rather to chooſe the old round, like a horſe in a mill, having no ſpirit or courage to improve, but content with each knowing the other's method, without ſtriving to excel, and diſcover more complete and leſs expenſive ways of working, and uſing the drugs to the beſt advantage.

I know not how men can ſit ſtill when there is more to learn. Let it not be ſaid of you, as of one of old, he lived and died and did nothing; perhaps he worked with his hands, but his head was aſleep; and therefore he was an unprofitable ſervant, and when dead, his memory was no more. Sure it is, the invitation I have to write and publiſh this ſmall pamphlet is not ſo much to pleaſe others, or to ſhew any thing I have is capable of the name

of

of parts, but to communicate my good wiſhes for improvement to my brethren the Dyers, and to ſhew them my willingneſs to help to perfect one of the moſt uſeful arts in the world.

I ſhall leave all to itſelf, and to every man's juſt liberty to approve, or diſapprove, as he pleaſes. And however it be, the author ſhall not be much troubled, for he is certain no man can have a lighter eſteem for him, than he has for himſelf; who, however, will be beſt pleaſed, if any man ſhall find benefit by what he has wrote. If any ſhould alledge a general acceptation, that, to the author, will be no prevailing argument; for the multitude, though moſt in number, are the worſt and moſt partial judges. He does not plead the importunity of friends for the publication of this. If it is worthy, it needs no apology; if not, let it be deſpiſed; and I remain the ſame friend to trade.

JAMES HAIGH.

A

HINT to the DYERS, &c.

BLACK being a primitive colour, and one of the most difficult to perfect, deserves a few remarks. If I ask a Dyer what ingredients compose a black, the answer will be this: Logwood, shumac, bark, and coperas; and if he knows it, he will add a little ashes and argol in the last wet. If I ask him which of these drugs contain an acid, which an alkaline, and which a neutral quality, he cannot give me an answer: so you see he knows the effect, but a stranger to the cause, and every thing else separate from fact and custom.

What a pity it is that men will not search things to the bottom, when they might be able to find out the cause of miscarriages, for which goods are frequently thrown aside to be dyed other colours, greatly to the Dyer's loss. In conversing with a sensible Dyer, I simply asked him, What part does logwood act in the black dye? the honest man as simply answered, "It helps to make it black." No other proof was wanted to know that he also followed his forefathers in the old round. But the

reader, by now, thinks it time to be informed of the business of logwood; which is (if used in a right proportion) to soften the goods, and give lustre to the colour. Logwood being possessed of a most excellent astringent quality, fixes itself in the pores of the goods, and gives them a velvet-like feel and gloss.

Some will object to this assertion, and say, but our blacks have not that velvet-like feel and gloss. True, sir, but don't you know the reason? you dye your blacks without scouring, forgetting, or not knowing, that when the goods enter the boiling dye-liquor, they grow harsh, and the oil contained in them forms a sort of resin, which becomes as fixed as if it was pitch or tar. This is one great cause why blacks are so liable to soil and dirty linen, because the dye is in some sense held in an outside or superficial state. Think then, is it possible these goods should finish soft like velvet, or shine like a raven's feather? No, on the contrary, they spoil the press papers, and come out stiff and hard like buckram, (not velvet) and are often three-parts perished in the finishing. No greater cause can be assigned for it than that of not scouring. This is the reason of the great difference, so much spoken of, between the London blacks and those dyed at Leeds. If the Leeds Dyers would take the same pains as the Londoners do, I think they would excel, in fact, if not in name.

The finishing shops in London are not more than half so well furnished with tools as those at Leeds are; and therefore let the Leeds Dyers be equally tight and clean in their performance, and there is nothing to prevent their superiority. But the master Dyers give a very reasonable answer to the foregoing. They say, the price is too low, and

and they cannot afford to take ſo much pains. What a pity that the merchants do not conſider this! if threepence a piece was added to the price for dying thin goods black, it would about pay for the ſcouring, and the goods would be finiſhed with a brilliant luſtre, and yet ſoft like a ruſſel.

I ſhould ſpeak a little to the nature and buſineſs of the other drugs, which enter the compoſition of black, had I not done it before, *(ſee the article black, Dyer's Aſſiſtant, p. 146.)*

I am aſtoniſhed at the ignorance of the poor cloth-makers, many of whom have applied to me frequently for inſtructions; one of them, on being aſked what ſort of ware, and how much he uſed to dye ſuch a colour, ſhewing him a pattern, he anſwered, When I have a pattern given me by a merchant, I go to the ſalter, ſhew him the order, and he ſerves me with what is wanted. I converſed with him ſome time, and would have inſtructed him, but alas! he had left his capacity at home, and I might as well have read the newspaper to him. What a pity it is that ſo many hundreds of that noble branch of buſineſs work, as it were, blindfolded, and poverty bitten too, for want of inſtructions, which they have no ſpirit to ſeek; who, when they bring a cloth to the market, are glad to ſell it for one and ſixpence, or two ſhillings in the pound profit, when they might as eaſily gain five or ſix ſhillings, if they knew how to uſe their drugs. But I deſpair of doing that for them, which nature has left undone; for, without I could teach them to ſee with a Dyer's eye, I might talk and write for ever in vain,

But there is another claſs of cloth-makers, to whom I will give a uſeful hint, and have done.

The article ſky-blue deſerves our notice. This colour is often ſubſtituted, (even on fine cloth) by the

the Saxon blue, on account of its brilliancy and fine lustre; but, like a fugitive, it only stays for a season. A little experience has taught me, that if a parcel of fine wool be well scoured, then sulphured or stoved, than which nothing can make it whiter, and then dyed in a weak vat, it will have all the beauty of the Saxon blue, without its imperfections. The vat used for this purpose should be set with a small quantity of indigo, on purpose for light shades, when the shades will be always brighter than when dyed in an old vat that has been weakened by dying dark colours. But the Dyers tell you that blues bear so low a price, and indigo is so dear, that they cannot afford to set fresh vats for light shades. Here is a sufficient cause, and one very great reason of retarding the perfection of many colours. If the wool before-mentioned should be obstructed in the milling, by means of the sulphur, (of which I have not had experience) I would commend the dying of the wool after scouring only, and stove it after it is milled, which I think will answer the same purpose; and the beauty of the colour will amply pay for every superfluous work.

I would recommend to the Dyers, after washing the dark blues well at the river, to turn the cloth very quick through a warm vessel of water, in which has been dissolved a little allum, and they will see a surprising change in the lustre from that simple process.

I am not willing to omit any thing worth notice in the course of my experiments. I will, therefore, lightly touch the properties of common water. By a great number of experiments, I am thoroughly convinced, that different waters with the same ingredients strike different colours. I

find

find that the pureſt and lighteſt waters ſtrike the beſt light colours.

All the dye-houſes at a diſtance from the river in London are furniſhed with wood ciſterns which hold perhaps from one to two hundred hogſheads of water, which is ſupplied from the water works, and is always impure, and frequently muddy; when on ſtanding a conſiderable time, as is the caſe at ſome ſeaſons of the year, it becomes putrid and emits a fœtid ſmell; if ſuffered to ſtand longer, it purifies itſelf, and becomes ſweet and clear, as well as conſiderably lighter. I have ſometimes filled a veſſel when the water has been all of a ferment, and ſtunk almoſt beyond bearing, which at a boiling heat was no more felt; by adding a handful of common ſtarch and a ſmall bit of allum, all the filth is made to riſe, and is taken off with a ladle for that purpoſe. The ſuperior goodneſs of the water obliges us to aſcribe an advantage to the London Dyers of light colours; add to this their remarkable cleanlineſs. When a veſſel is boiling they watch it carefully, and with a mop, kept for that purpoſe, they rub off the ſcum all round at the water's edge, ſo that the liquor is perfectly clear.

A ſhort Remark on the Dye of Braſil wood.

It is impoſſible to wear a red, a dove colour, a crimſon, purple, light or deep violet, or any other colour, the produce of Braſil wood uſed recently many weeks, without fading, ſpotting, or ſoiling. If theſe colours were dyed in grain they would indeed coſt ſomething more, but you have then a colour which will continue beautiful as long as the ſtuff or cloth will laſt; and if ſpotted with dirt or greaſe, can eaſily be ſcoured and cleaned without danger of loſing or injuring the colour.

I boiled

I boiled fifty pounds of Brasil chips one hour, in a copper of the hardest spring water I could find, and carefully took off the scum, turned this liquor over into a large tub, and re-heated the copper to boil the chips a second time, when the colour was all extracted. I then put both liquors together, and let it stand six months, when it was ropy and thick like oil. Now having prepared a small piece of fine cloth in allum and sour bran-water, and kept it moist five days unwashed out of the allum, I boiled one nut-gall and one quart of Brasil liquor ten minutes, then rinsed my piece of cloth, and dyed it a very beautiful marone. But the chief remark I intend to make here, is, that I hung this piece of cloth in the open air night and day during four severe winter months, and it had rather gained in beauty of colour, and was grown rather deeper. This is a sufficient proof that chymistry hath a power of securing the fine particles of those vegetables which are now called bastard drugs. Experiments (which are the best guides in natural philosophy, as well as in arts) plainly shew that a great advantage might arise in favour of the studious practitioner, who is not wearied if he miss his design after twenty or thirty trials, but still pursues his plan till he has hit it; for nothing of the kind seems to be impossible.

A few Experimental Observations on the Dye of Cochineal.

After all the common processes of dying with cochineal, there is found at the bottom of the vessel a deep brown sediment. This sediment appears to consist of the impurities of the tartar, and the grosser parts of the powdered cochineal. This being lightly washed with clear cold water, dried and

and ground on a marble, with one-fourth its weight of fine tartar, into an impalpable powder, and then put into water with a little allum, a piece of white cloth boiled in this liquor three quarters of an hour acquired a very beautiful crimſon dye.

This experiment evinces, that, by reducing cochineal into a powder of moderate fineneſs as commonly practiſed, we do not gain all the advantage which this valuable commodity is capable of yielding.

If the cochineal, when taken from the veſſel, (after the ſcarlets are dyed) is treated as above, the ſaving in the cochineal, whether for ſcarlet or crimſon, will be about one-third. Though leſs tartar is uſually employed in the dye-liquor, yet this quantity here directed does no harm; it appeared on trial that the colour was rather the more ſolid for it. All urinous and alkaline liquors or ſubſtances ſtain ſcarlet to a crimſon, by deſtroying the effect of the acid. Hence, in pure country air, ſcarlet retains its luſtre much longer than in cities and towns, where alkaline and urinous vapours are more abundant. The dirt of roads and ſundry ſubſtances of the acrid kind, leave no ſtain on ſcarlet, if the part be waſhed immediately in pure water, and wrung in a clean linen cloth. If the dirt is ſuffered to dry, a blackiſh violet ſpot will remain, which can only be diſcharged by mild vegetable acids, as vinegar, citron juice, a warm dilute ſolution of cream of tartar, or ſour bran-water; if theſe acids, however, be not applied with a good deal of addreſs, whilſt they take out the blackiſh ſtain they leave a yellow one, by diſſolving the colouring particles of the cochineal itſelf.

After at leaſt a thouſand experiments, I am obliged to conclude, that the dying of wool is the moſt extenſive branch of this art, it may be conſidered

ſidcred as its baſis; but the dying of ſilk, thread, and cotton, deſerves alſo our attention.

The great difference between thoſe ſubſtances, and that of wool, is well known to the callico printers, whoſe grand care it is to find means of making linen receive the ſame dyes as wool does. The phyſical cauſe of the difference ſeems yet unknown; and indeed, as before obſerved of dyes in general, we know as yet very little. Are animal filiments tubular, and the colouring atoms received within them? are vegetable filiments ſolid, and the colour depoſited on the ſurface? or, does not their different ſuſceptibility of colour depend rather on the different intrinſic properties of the two? An anſwer to this would doubtleſs prove of great utility.

I ſhould be happy to find ſome artiſt undertake to improve what I have in a poor way begun. I long to ſee the art in perfection, one half of which is yet in oblivion.

The reader may be aſſured, that what is here recited is purely the reſult of the author's own experience, (not theory) and part of the effects of many years ſtudy.

THE END.